Secondary Treatment Facilities Plan

Volume I

Executive Summary

DRAFT REPORT

November 13, 1987

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Notice to Reviewers

Attached for your review is Volume I Executive Summary, of the Secondary Treatment Facilities Plan.

To date the MWRA staff and Board of Directors have not reviewed this document but they have been briefed on its contents. No approval will be issued until the public review process is complete. The report is being circulated at this time to seek early review and comment by interested parties. Comments will be presented to the Board of Directors as they continue their review of the draft report.

Information in this report is current as of November 13, 1987.

Daniel K. O'Brien
Acting Director
Engineering Division
November 13, 1987

HOW TO USE

THE

SECONDARY TREATMENT FACILITIES PLAN

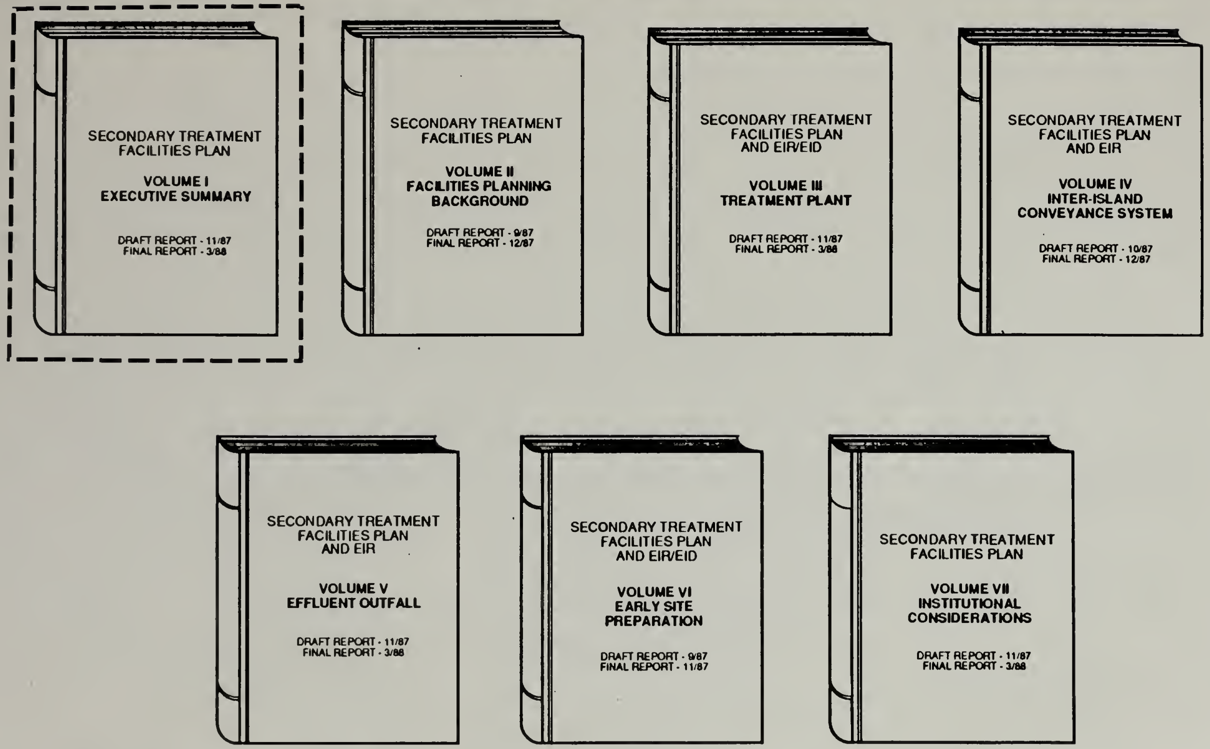
The Secondary Treatment Facilities Plan is organized into seven volumes.

The major components of the Secondary Treatment Facilities Plant are: Treatment Plan, Inter-Island Conveyance, Effluent Outfall, and Early Site Preparation.

The Secondary Treatment Facilities Plan document consists of a stand-alone volume for each of these components, as well as volumes for Facilities Planning Background, Institutional Considerations, and Executive Summary.

Each volume may be referenced to find complete planning information pursuant to that project component. The seven volumes are numbered as follows:

Volume I	Executive Summary
Volume II	Facilities Planning Background
Volume III	Treatment Plant
Volume IV	Inter-Island Conveyance System
Volume V	Effluent Outfall
Volume VI	Early Site Preparation
Volume VII	Institutional Considerations



MASSACHUSETTS WATER RESOURCES AUTHORITY

DEER ISLAND SECONDARY TREATMENT FACILITIES PLAN VOLUMES

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Section 1

1.0 INTRODUCTION

1.1 VOLUME IDENTIFICATION

The following is Volume I, Executive Summary of the Deer Island Secondary Treatment Facilities Plan. It is the first of seven volumes which summarizes the six subsequent volumes.

1.2 BRIEF DESCRIPTION OF PROJECT

The existing Massachusetts Water Resources Authority (MWRA) wastewater collection system consists of a North System and a South System. Currently, wastewater from the South Metropolitan Sewerage System is treated at the Nut Island Primary Treatment Plant and wastewater from the North Metropolitan Sewerage System is treated at the Deer Island Primary Treatment Plant.

The Secondary Treatment facilities plan evaluates the facilities needed to provide primary and secondary treatment of the wastewater conveyed through the MWRA's North and South sewerage collection systems at a single treatment facility to be located on Deer Island. The Facilities Plan also evaluates the facilities needed to convey the South System flows from the existing Nut Island Plant to Deer Island, and the outfall facilities needed to convey the treated effluent from Deer Island to a disposal point in marine waters.

1.3 ORGANIZATION OF THE REPORT

Each section of this Executive Summary corresponds to a volume of the Facilities Plan. A brief description of the contents of each volume follows.

Volume II, Facilities Planning Background, describes the need for the planning project and the planning approach. It summarizes previous studies for the clean-up of Boston Harbor and other harbor-related projects. It also outlines the decision making process in the siting of the new facilities, and the court-ordered dates for implementation of the Facilities Plan. Volume II describes the planning period and the service area for the facilities, projected flows and loads, and criteria used to evaluate all of the possible treatment processes in order to determine the most feasible, effective methods of treatment. The existing treatment facilities, environments, and regulations, are also examined in Volume II as well as the environmental regulations that will impact the construction of the planned facilities.

The facilities needed to provide secondary treatment include the following: new primary and secondary treatment facilities located on Deer Island, and preliminary treatment facilities at Nut Island; a new conduit to convey the South System wastewaters from Nut Island to Deer Island (inter-island conveyance facilities); and a new outfall to discharge the treated effluent into the ocean.

The initial implementation phase of the treatment plant construction program is early site preparation. Early site preparation included the construction activity that can start before

the completion of the on-island piers facilities. The planning for the facilities needed to provide secondary treatment and the early site preparation project are presented in four, stand-alone volumes:

Treatment Plant, Volume III
Inter-Island Conveyance System, Volume IV
Effluent Outfall, Volume V
Early Site Preparation, Volume VI

Volume VII, Institutional Considerations, identifies the permitting, program management, financing, human resources and regulatory requirements for constructing and operating the recommended facilities within the schedule entered by the Federal Court. The analysis includes a review of the court-ordered target dates and recommends the changes in the schedule that are deemed necessary.

Section 2

2.0 FACILITIES PLANNING BACKGROUND

2.1 PROJECT NEED

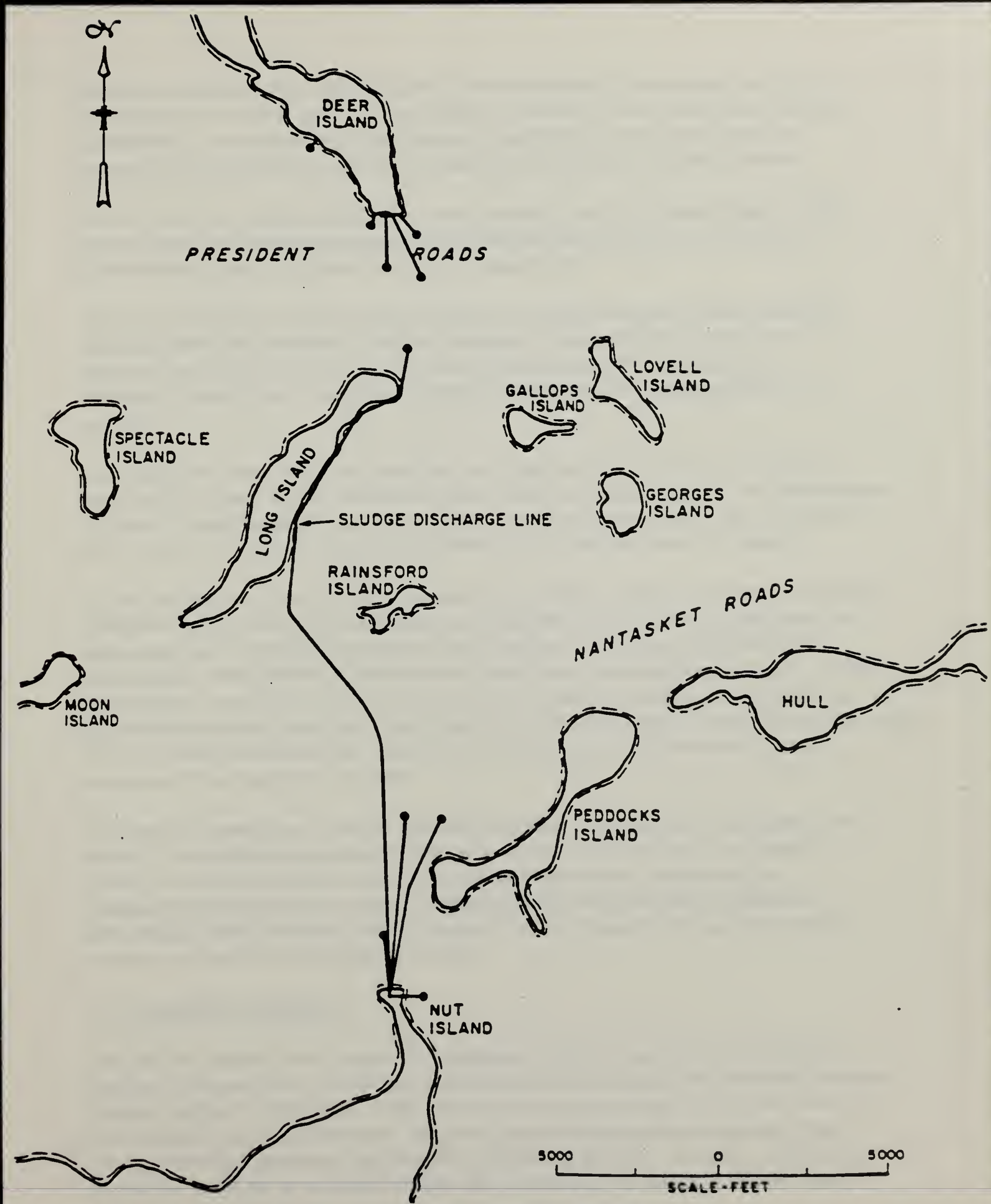
Since the time of the Revolutionary War, Boston Harbor has been considered a national landmark. The largest seaport in New England, it supports a variety of marine activities including shipping, fishing, boating and recreation. It encompasses an area of 47 square miles bordered by residences, commercial buildings, restaurants, marinas, beaches, industries and shellfishing flats. But since the settlement of Boston's shore areas, and most particularly since the City of Boston took possession of Deer Island for "sanitary purposes" in 1847, the harbor has been the receiving water for all of the domestic, commercial and industrial wastewater and stormwater from the Boston metropolitan area.

Today, nearly 5,000 miles of sewers, conduits and pipes collect wastewater from 1.9 million people in 43 metropolitan cities and towns and transport it to the area's two wastewater treatment plants at Nut Island and Deer Island for treatment prior to discharge to Boston Harbor. Both of the plants are designed to provide primary treatment. Each plant provides disinfection of the primary effluent to reduce the levels of pathogenic bacteria prior to discharge to the harbor. The disinfected effluent from Deer Island is discharged through two diffuser-equipped outfalls into President Roads approximately 1,500-2,000 feet from Deer Island. Three additional relief outfalls are located 500-750 feet from Deer Island.

The disinfected effluent from Nut Island is discharged north through two main outfalls into Nantasket Roads approximately 5,500-5,800 feet from Nut Island. During periods of high flows and/or extremely high tides a third outfall extending about 1,500 feet north into the West Gut side of Hingham Bay may be used. In addition, an emergency outfall extends 600 feet into the Hingham Bay side of West Gut.

The sludges removed at both plants are anaerobically digested and discharged into President Roads on the outgoing tide. Figure 2-1 illustrates the location of each of the treatment facilities and discharge locations. The combined discharge of primary effluent and sludge to the relatively shallow waters of Boston Harbor imposes a significant burden on the marine ecology in the waters surrounding the discharge points. The discharge of floatable materials results in a significant deterioration in the aesthetic qualities of the harbor waters.
Because these discharges of wastewater and sludge are but a few of the total discharges to Boston Harbor, and because scientific research to delineate the impacts of each discharge on the harbor has been limited to date, the precise impacts of the primary effluent and sludge are difficult to quantify. However, these discharges are unquestionably very sizable and the materials being discharged are ecologically significant. Thus, every reasonable effort should be made to reduce these discharges.

The Deer Island treatment facility was constructed in 1968, and the Nut Island treatment facility in 1952. Both facilities have exceeded their useful lives and the levels of treatment



MASSACHUSETTS WATER RESOURCES AUTHORITY	FIGURE 2-1 DEER ISLAND AND NUT ISLAND EFFLUENT AND SLUDGE DISCHARGE LOCATIONS

provided are often less than optimal because of the unavailability of replacement equipment. Nut Island has recently undergone a rehabilitation of most of its major components. A similar rehabilitation is now underway for Deer Island. Rehabilitation of the existing treatment facilities will optimize the levels of removal that these facilities can consistently provide.

However, even the rehabilitated facilities cannot provide the levels of treatment desired. The design criteria and installed equipment of the existing primary facilities do not represent present day technology; therefore, they require replacement.

The 1972 Federal Clean Water Act requires that all municipal wastewater treatment systems incorporate secondary treatment. Secondary treatment is more complex than the primary treatment that the flows at Nut Island and Deer Island currently receive, removing significantly higher levels of both organic materials and solids from wastewater (80 to 90 percent).

Like the Federal Water Pollution Control Act, the Massachusetts Clean Water Act requires promulgation of water quality standards for waters within the Commonwealth. The Massachusetts Division of Water Pollution Control has established these standards to satisfy the requirements of both acts. Thus, both federal and state statutes require increased levels of treatment.

In 1982, the City of Quincy filed a suit against the Metropolitan District Commission (MWRA's predecessor agency) charging violations of laws prohibiting discharges into coastal waters and tidal waters, and violations of the common law of nuisance. As the suit progressed, the Massachusetts Water Resources Authority was created by the Massachusetts legislature. Almost simultaneously with MWRA's creation, the U.S. Environmental Protection Agency filed suit against MWRA alleging violations of the Clean Water Act. The Federal District Court found MWRA to be in violation and ordered the Authority to plan and construct new treatment facilities in accordance with an aggressive schedule.

The need for upgraded and expanded treatment facilities to serve the Boston metropolitan area is clear: current discharges place a significant burden on one of the area's vital natural resources; the existing treatment facilities have long exceeded their useful lives; the existing treatment facilities do not reflect present day technology and design; Federal and State statutes require enhanced levels of treatment; and the Federal Court has intervened and ordered an upgrading of the treatment facilities.

2.2 PLANNING APPROACH

This facilities planning study provides the foundation for the Massachusetts Water Resources Authority's program for the construction and operation of new primary and secondary wastewater treatment facilities at Deer Island. This planning has been approached with the understanding that the facilities planning effort must secure and sustain the acceptance and support of the diverse community, government and business interests that it affects. Therefore, the planning process was based not on technical strength alone, but also on the continual reconciliation of political, legal, environmental, economic and community interests.

A critical component of the facilities planning for secondary treatment facilities has been completed: the siting of the new treatment facilities. On February 3, 1986, the MWRA made its final selection of a site for the proposed harbor island wastewater treatment plant. The selection of Deer Island as the location for the new facility brought to a close eight years of evaluation, discussion, comment and refinement of siting issues. Most of the history of the process, and information explored, is contained in the Supplemental Draft Environmental Impact Statement/Draft Environmental Impact Report (SDEIS/DEIR) and the MWRA's Final Environmental Impact Report on the Siting of Wastewater Treatment Facilities in Boston Harbor (FEIR).

Recognizing the need to adopt all feasible measures to mitigate the adverse environmental impacts, the MWRA, as part of the FEIR, set forth a series of mitigation commitments designed to alleviate the impacts associated with the construction and operation of the Deer Island plant. During the process of making its final siting decision the MWRA reviewed the public comments on the proposed mitigation commitments and the comments received from the Secretary of Environmental Affairs and adopted a final series of mitigation commitments. These commitments cover the following areas:

- Flow and growth
- Operation and maintenance
- Noise
- Barging and Busing
- Use of liquid chlorine
- Relocation of Deer Island House of Correction

The decision-making process and the mitigation commitments made during the siting process were considered to be firm guidance for the planning to be undertaken in this project.

In facing the monumental tasks associated with the successful implementation of the Deer Island Secondary Treatment Facilities Plan, the Authority instituted a comprehensive public participation effort. The measures included were designed to meet federal and state regulatory requirements associated with the project, to satisfy grant conditions, and to provide the most meaningful avenues of public input into the critical decisions to be made by the Authority. Through this program, the Authority's dialogue with the public has been ongoing and important policy decisions have been made and will continue to be made within the context of maximum public knowledge and participation.

The successful treatment of wastewaters from the Boston metropolitan area requires not only that enhanced treatment facilities be provided, but also that reliable, environmentally sound facilities be provided to manage the disposal of the residuals that are the direct by-products of wastewater treatment. The residuals management facilities plan is being conducted as a separate but concurrent study. The facilities needed and the sites being considered for residuals management are quite different from those needed for secondary treatment. However, the schedule for completion of the residuals management facilities plan is similar to the schedule for this plan. In addition, the approach and work plans for both of these planning studies recognize the synergistic relationship of these two plans. Thus, this planning study must be read with full cognizance of the residuals management facilities planning.

To expedite the planning and review process, the facilities planning for secondary treatment has received a designation as a "major and complicated" project under the Massachusetts Environmental Policy Act regulations. The "major and complicated" project designation permits the environmental reviews to be concurrent with, and an integral part of, the facilities planning process. Thus, the documents being prepared to summarize the facilities planning are the same documents which will be used for environmental reviews.

2.3 RELATED PROJECTS

Although the Secondary Treatment Facilities Plan is the beginning of the key project in the Boston Harbor Clean-Up Program, there is a long list of projects that are being planned, designed or are under construction to upgrade and expand the MWRA's wastewater collection and treatment capabilities. These projects are grouped into the following programs:

- Treatment Plant Upgrade
  - Nut Island Immediate Upgrade
  - Deer Island Fast-Track Improvements
- Interim Residuals Management
  - Interim Sludge Processing and Disposal
  - Interim Scum Management
- Long-Term Residuals Management
- Water Transportation Facilities
- Combined Sewer Overflows
- Harbor Research and Monitoring

In addition to the above wastewater programs, several waterworks projects have either a direct or an indirect bearing on the secondary treatment facilities planning. MWRA has also initiated several projects to strengthen its ability to direct and manage its extensive capital program and its formidable day-to-day operational responsibilities.

2.4 BASIC PLANNING CRITERIA

2.4.1 PLANNING PERIOD

The planning period used in this facilities plan encompasses the period from now through the year 2020. This represents the first twenty years of operation of the secondary plant, which has been stipulated by the federal court to be in operation not later than the end of 1999.

The use of twenty-year planning periods is considered generally accepted practice in the engineering profession, and is required by construction grant regulations issued by the U.S. Environmental Protection Agency (EPA).

2.4.2 SERVICE AREA

Under its enabling legislation, MWRA is charged with providing treatment to the wastewaters generated in 43 municipalities and special districts. The legislation permits permanent sewer service to other communities, but only after these communities have shown that no feasible alternatives exist, and after numerous regulatory and legislative approvals have been obtained.

Expansion of the service area, if it takes place, will occur at the boundaries of the existing service area. Figure 2-2 shows the existing service area, together with communities which are adjacent to the boundary of the area. Most of the communities abutting the Authority's service area are already served by a wastewater system. Any system expansion which might be considered would be on a very limited basis due to existing wastewater utilities on the perimeter of the MWRA service area. Therefore, in developing population and flow projections, the existing service area was used as a base.

As mentioned, MWRA owns and operates two wastewater treatment plants, one at Deer Island and the other at Nut Island, which handle wastes from the North and South Metropolitan Sewer Service Areas, respectively. Some communities in the service area are serviced by both plants.

The Nut Island Facility (servicing the South System) presently serves the following twenty-one communities:

Ashland	Hingham (N. Sewer Dist.)	Quincy
Boston (portion)	Holbrook	Randolph
Braintree	Milton (portion)	Stoughton
Brookline (portion)	Natick	Walpole
Canton	Needham	Wellesley
Dedham	Newton (portion)	Westwood
Framingham	Norwood	Weymouth

The South System encompasses an area of approximately 240 square miles and at present has a total population of approximately 750,000 and a contributing population of approximately 630,000. Five MWRA pumping stations are located throughout the South System contributing area.

The Deer Island Facility (servicing the North System) serves twenty-six communities. The area served by this treatment plant is approximately 170 square miles with a total population of approximately 1,300,000 and a contributing population of approximately 1,250,000. Six MWRA pumping stations are located throughout the North System contributing area. Member cities and towns include:

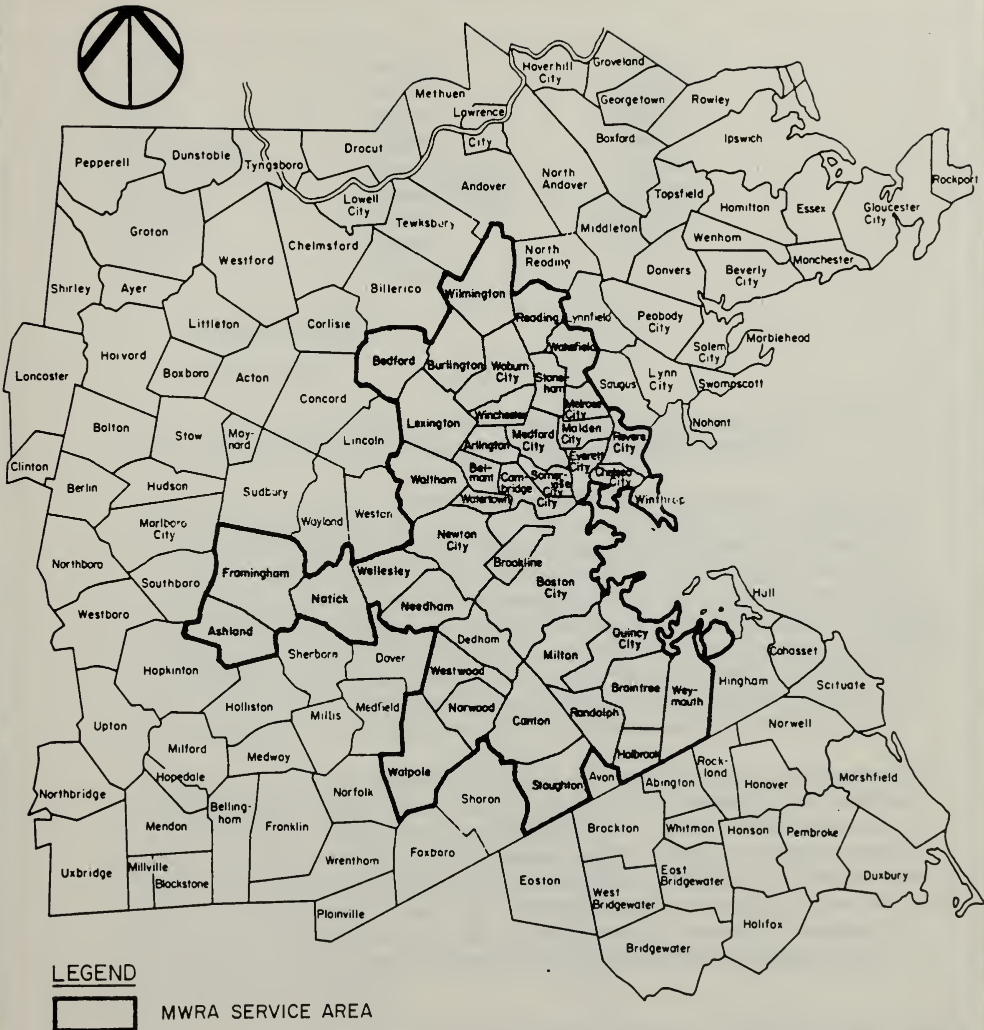


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FIGURE 2-2
MWRA SERVICE AREA

Arlington	Lexington	Stoneham
Bedford	Malden	Wakefield
Belmont	Medford	Waltham
Boston (portion)	Melrose	Watertown
Brookline (portion)	Milton (portion)	Wilmington
Burlington	Newton (portion)	Winchester
Cambridge	Reading	Winthrop
Chelsea	Revere	Woburn
Everett	Somerville	

2.5 EXISTING FACILITIES

2.5.1 NORTH SYSTEM

Currently, influent flow from the North Metropolitan Sewerage System enters the Deer Island Plant through the Main Pumping Station and the Winthrop Terminal Headworks.

Flow entering the plant through the Main Pumping Station receives preliminary treatment, consisting of screening and grit removal, at one of the three remote headworks: Chelsea Creek, Ward Street, and Columbus Park. Effluent from each headworks is discharged to a vertical shaft, then conveyed through one of two deep rock tunnels to the Main Pumping Station at Deer Island. The first tunnel, the Boston Main Drainage Tunnel, is approximately 7 miles long. It crosses under Boston Harbor from Deer Island to South Boston where it connects to the Columbus Park Headworks. The Boston Main Drainage Tunnel continues from Columbus Park to the Ward Street Headworks located off Huntington Avenue, near the Wentworth Institute of Technology. The second rock tunnel, the North Metropolitan Relief Tunnel, is approximately 4 miles long. It connects the Chelsea Creek Headworks to the Main Pumping Station at Deer Island.

The Winthrop Terminal Headworks screen and pump influent flow that arrives at Deer Island via the North Metropolitan Trunk Sewer. This sewer is the original interceptor to Deer Island and is roughly paralleled by the North Metropolitan Relief Tunnel. The North Metropolitan Trunk Sewer receives flows from Winthrop, Orient Heights, and Deer Island, and overflows from the Chelsea Creek Headworks via the East Boston Pumping Station. The North Metropolitan Trunk Sewer has a peak capacity of 125-mgd. The Winthrop Terminal was designed to screen this entire flow and to provide grit removal for 60-mgd. Flows receiving grit removal are discharged to the primary plant. Flows in excess of the capacity of the grit system are discharged directly to the Deer Island Plant bypass.

The North System components are shown schematically in Figure 2-3. During peak flows, normally caused by wet weather flows from the numerous combined sewers of the North Metropolitan System, the Boston Main Drainage and North Metropolitan Relief Tunnels are selectively throttled at the three remote headworks, thereby diverting flows in excess of the plant's capacity to CSOs.

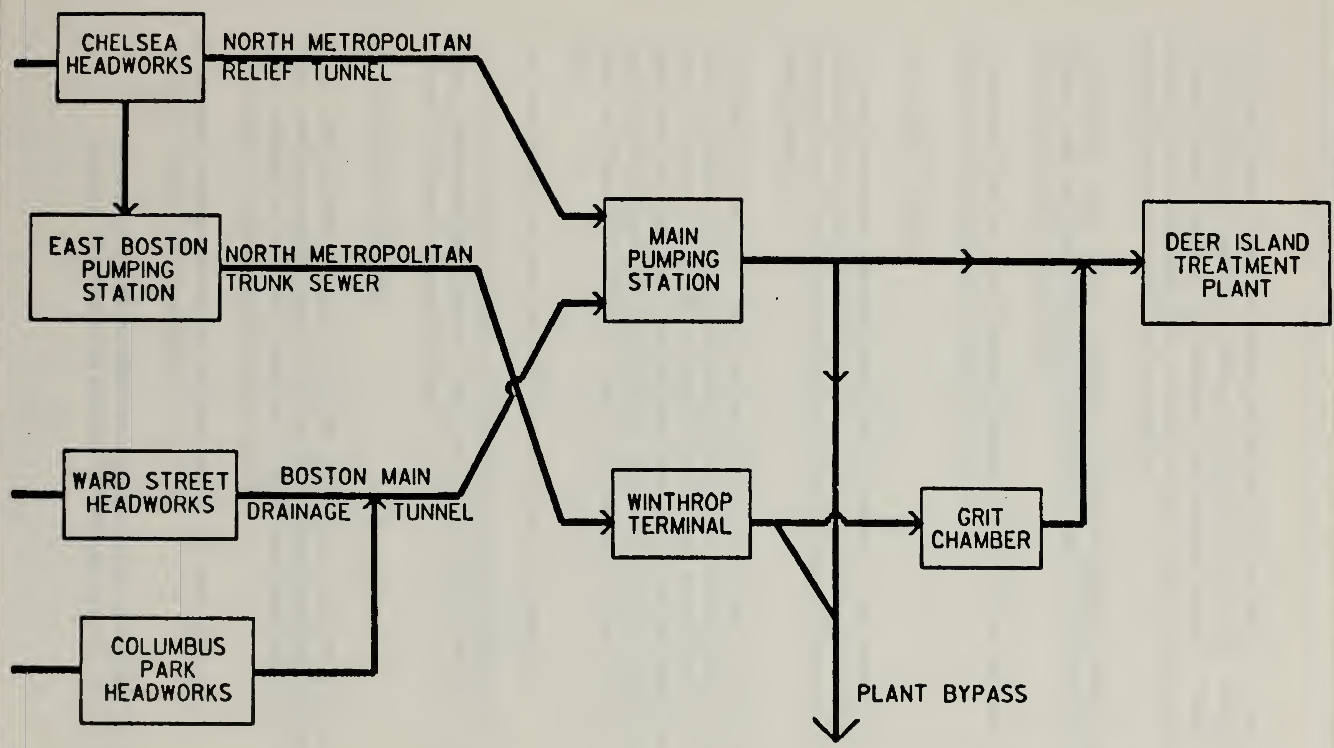

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FIGURE 2-3
NORTH SYSTEM HEADWORKS AND TUNNEL SCHEMATIC

The existing primary wastewater treatment plant at Deer Island was designed to treat an average flow of 343-mgd and a peak flow of 848-mgd. Influent flow from the Main Pumping Station and Winthrop Terminal Headworks are discharged to two preaeration channels. Primary treatment is provided by eight sedimentation tanks. Effluent from the primary tank is then chlorinated and discharged to the harbor through a series of outfalls.

Primary sludge, grease, and scum is collected, thickened, and pumped to anaerobic digesters. Digested sludge, and bypass flows from the Winthrop Terminal, are mixed with the primary effluent prior to discharge to the harbor.

A schematic of the Deer Island Wastewater Treatment Plant showing the flow pattern and the arrangement of treatment units is presented in Figure 2-4.

2.5.2 SOUTH SYSTEM

The South Metropolitan Sewerage System consists of a network of approximately 78 miles of MWRA interceptor sewers, five pump stations which are owned and maintained by the MWRA, and the existing Nut Island treatment plant. There are no remote headworks on the South Metropolitan Sewerage System.

The High Level Sewer (HLS) conveys wastewater from the South System to the Treatment Plant in Quincy. It begins in the Parker Hill section of Roxbury, just south of the North Metropolitan System's Ward Street Headworks, and extends, about 15 miles, through Hyde Park, Milton and Quincy to the Nut Island Plant. Along the sewer route, major flows are received from MWRA extension sewers including the Brighton Branch, Neponset Valley Sewer, Upper Neponset Valley Sewer, New Neponset Valley Sewer, Wellesley Extension Sewer, and the Wellesley Extension Relief Sewer.

Main components of the South Metropolitan System are shown in Figure 2-5.

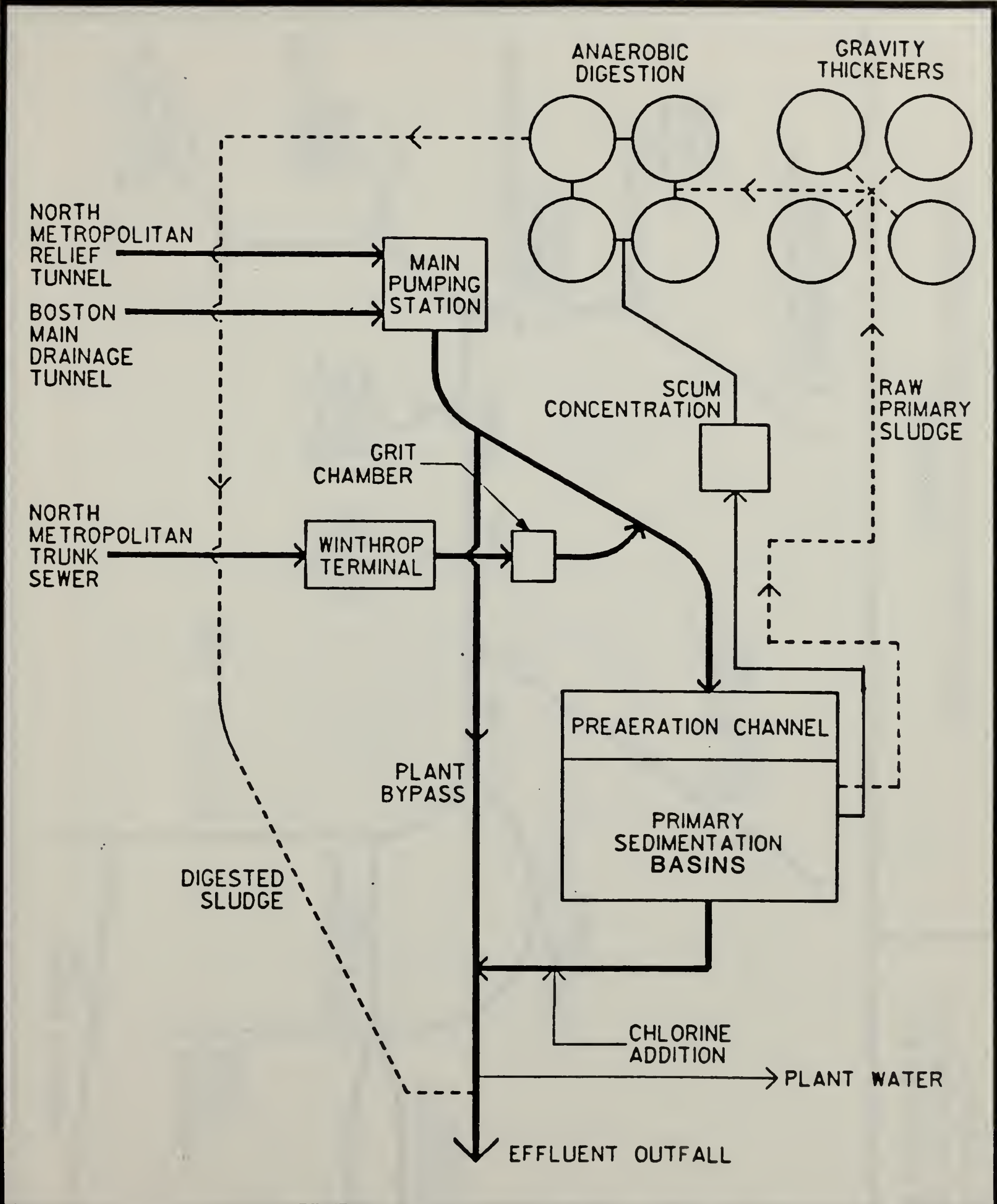
The Nut Island Wastewater Treatment Plant provides screening, grit removal, preaeration, primary sedimentation and disinfection. Plant effluent is discharged to the harbor. A schematic of the plant is presented in Figure 2-6.

2.6 EVALUATION CRITERIA

As part of the Secondary Treatment Facilities Plan development, major decisions were made to select a wastewater treatment process; to size and locate conduits and pumping stations to convey wastewater to, and treated effluent from, the Deer Island Treatment Facility; and to plan the initial site preparation program at Deer Island.

In evaluating the various alternatives, four broad categories of criteria have been established. These include the following:

- Environmental Criteria, which focus on air emissions, noise, traffic and marine resources, and measure the potential environmental impacts of each alternative;



MASSACHUSETTS WATER RESOURCES AUTHORITY	FIGURE 2-4 DEER ISLAND WASTEWATER TREATMENT PLANT SCHEMATIC

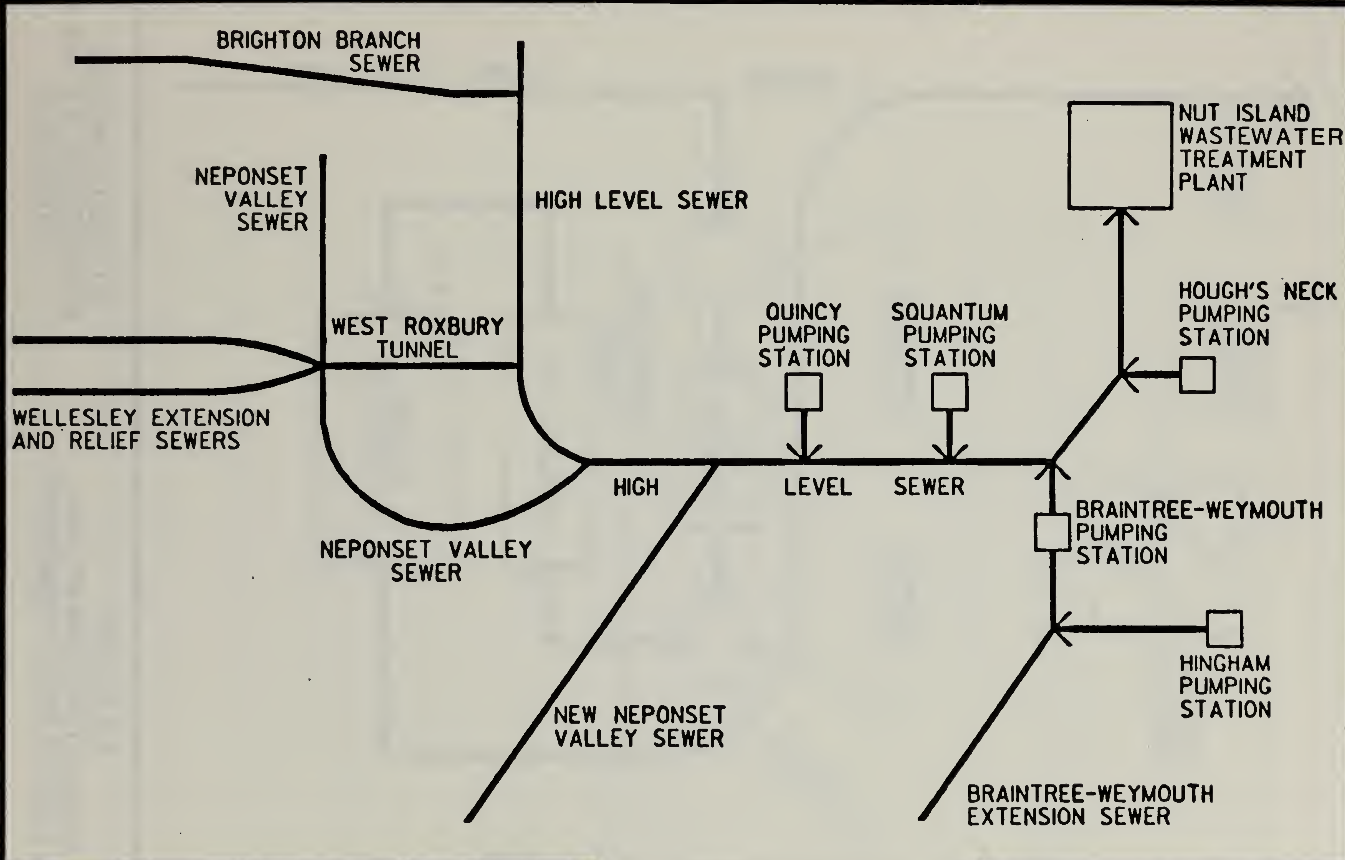


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FIGURE 2-5
SOUTH COLLECTION SYSTEM SCHEMATIC

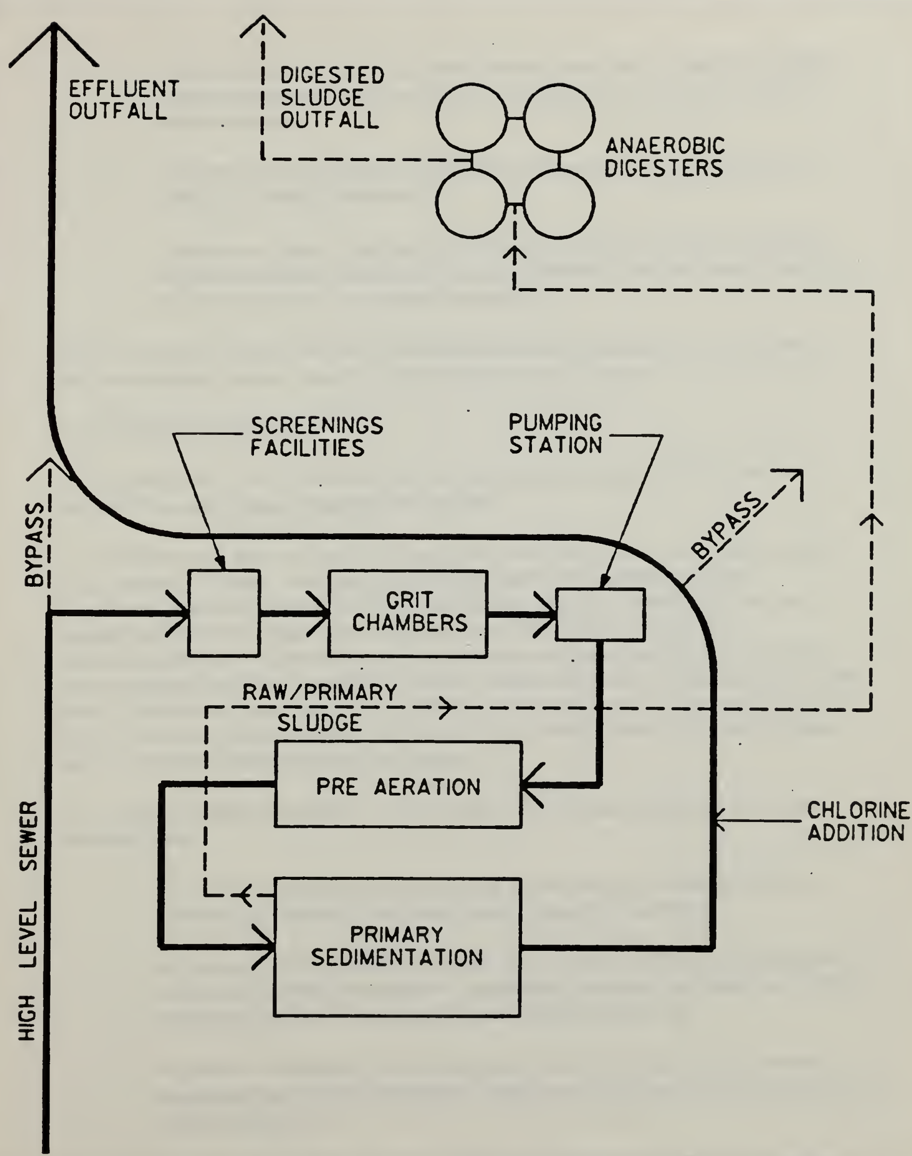

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FIGURE 2-6
NUT ISLAND WASTEWATER TREATMENT PLANT SCHEMATIC

- o Technical criteria, which focus on engineering issues such as reliability, flexbility, constructibility, operational complexity, area requirements, staffing requirements, and power needs;

- o Cost criteria, which present the financial investment necessary to construct and operate the various alternatives;

- o Institutional criteria, which assess the differences among alternatives according to the time required for construction and the coordination required among a wide variety of public and private organizations and agencies.

These criteria were used to select the recommended plan, which provides the most technically and environmentally sound, cost-effective and implementable alternative.

2.7 FLOWS AND LOADS

Of initial importance in the sizing and design of the wastewater treatment facilities are the estimated flows and loadings expected at the facilities.

The wastewater and associated pollutants received at the MWRA's treatment facilities originate from a variety of sources: domestic wastewater associated with residential activities; nondomestic wastewater associated with the commercial, industrial, institutional, and other business activities of the region; infiltration and inflow (I/I); and stormwater flow. Infiltration and inflow is water other than domestic and nondomestic wastewaters that enters sewers unintentionally, and results from the age, condition and location of the more than 5,000 miles of public sewer pipe tributary to the MWRA's treatment facility. Stormwater flow is the flow that results from the combined systems which carry both wastewater and street drainage, and is intentionally allowed into the sewer system.

The volume of wastewater produced in the Authority's service area is directly related to the following factors:

- o the sewered population of the service area and the volume of water used by the residents and returned to the sewer system as domestic wastewater;

- o the economic activity taking place within the service area which drives area growth and employment and thus the volume of nondomestic wastewater discharged as a result of commercial, industrial, manufacturing and employee usage; and

- o the rainfall in the service area, which enters the sewer system as I/I or as direct stormwater flow, and the groundwater levels in the service area which, when high, add to the volume of I/I.

The total domestic and nondomestic wastewater flows will average about 239 mgd by the year 2020. This assumes a total domestic wastewater flow of 126 mgd based on a service area population of 2.1 million in the design year, and total nondomestic wastewater flow of 103 mgd.

I/I and direct stormwater runoff account for a significant amount of flow in the MWRA sewer system. Seasonal flow variations have been documented and are a direct response to variations in I/I. The spring months have notably higher flows than the remainder of the year due to higher groundwater elevations which result in increased I/I. Due to this phenomenon, I/I flows were estimated for two periods: high groundwater conditions (normally February - May); and low groundwater conditions (normally June - January). Average I/I is expected to vary from approximately 150 mgd to 430 mgd.

Annual nonstorm flow to the plant in the design year is expected to average 480 mgd, based on average flow of 390 mgd during low groundwater conditions and 670 mgd during high groundwater conditions.

Within the communities of Boston, Brookline, Cambridge, Chelsea and Somerville (exclusively in the North System) are approximately 12,900 acres with combined sanitary and storm sewers. During storms, runoff reaches the plant via these combined sewers. Stormwater runoff in excess of the transmission capacity of the sewer system is discharged to nearby water bodies as combined sewer overflow (CSO). The maximum capacity for headworks receiving stormwater runoff, and for the proposed headworks at Nut Island serving the South System service area, is shown below.

	Transmission System Capacity (mgd)
Ward Street	256
Columbus Park	182
Chelsea Creek	350
Winthrop Terminal	125
Subtotal North System	913
Subtotal South System	360
TOTAL	1,273 (rounded to 1,270 in subsequent tables)

Maximum daily non-storm flows will range from 600 mgd to 950 mgd depending on the time of the year. Since the maximum hydraulic capacity of the transport system is approximately 1,270 mgd, from 320 to 550 mgd of capacity is available to accept stormwater flows in the North System at maximum day wastewater flow conditions.

Recent proposals for CSO management envision storage and pumpback of storm flows to the plant. These additional flows are planned to range from 200 to 300 mgd over a period of one to two days. The flow projections used for this study include ample capacity for pumpback of stored CSO.

A summary of the projected flows (rounded to the nearest 10-mgd) are presented in Table 2-1. Figure 2-7 summarizes the design year flow, by components, for low and high groundwater conditions.

Treatment plant loadings have been described in terms of two general categories: conventional pollutant loadings and non-conventional pollutant loadings. Conventional pollutants, defined as Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) are parameters commonly used to define wastewater strength.

Estimates of future year average annual conventional pollutant loadings were developed using two steps. First, the current plant loadings were ascertained from historical records and sampling data collected as part of the Facilities Plan. Second, loading allowances were made for the capture of existing dry weather overflows and CSO management as well as allowances for increased solids contributed to the plant as a result of growth in domestic and nondomestic flows. Additional loadings equaling 10 percent of the influent loads were included as an allowance for sidestreams from sludge processing in the sizing of individual unit processes.

Estimates for conventional pollutant loads from stormwater were developed by analyzing pollutant mass accumulation over the combined sewer service area. The accumulation of pollutants on the land is primarily a function of land use and time between storms. During a major storm event, runoff carries pollutants on the land surface into the combined sewer system. After the storm event, the mass of pollutants begins to accumulate again. The accumulation continues until the next storm event when all or some of the pollutant mass is carried by runoff to the combined sewer system.

Table 2-1 presents estimated design year BOD and TSS loadings.

The wastewater sampling program conducted in the fall of 1986 and the spring of 1987 characterized the existing nonconventional pollutants loading at Nut Island and Deer Island Treatment Facilaities. A summary of the results of the sampling program for metals, acid base neutrals, and VOAs is shown in Tables 2-2 through 2-4. No pesticides or PCBs were detected in any of the samples.

Nonconventional pollutant loadings (metals, acids and base neutrals organics, volatile organics, pesticides and PCBs) to Deer Island will increase in the future in proportion to the increase in future wastewater flow to the plant (approximately 15 percent) and the degree to which CSOs are captured. For selected nonconventional pollutants the CSO increase ranges from a few percent up to 25 percent compared to existing loadings, assuming that all CSOs are captured and returned to the plant.

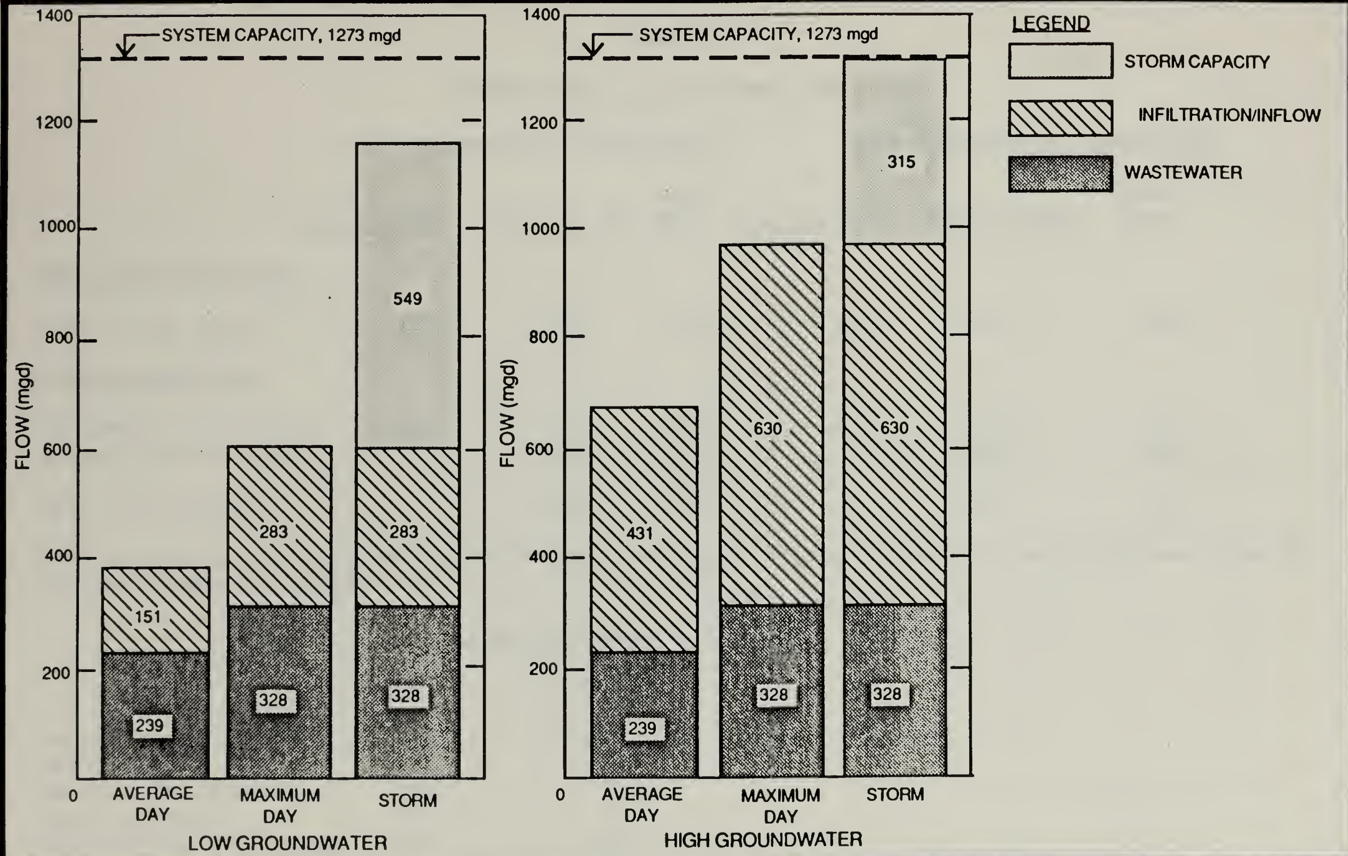

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FIGURE 2-7
SUMMARY OF DESIGN YEAR FLOWS AND LOADS

TABLE 2-1

DESIGN YEAR (2020) FLOWS AND LOADS

	LOW GROUNDWATER CONDITIONS			HIGH GROUNDWATER CONDITIONS		
	Average Day	Maximum Day	Peak Hour	Average Day	Maximum Day	Peak Hour
NON-STORM CONDITIONS						
Total Flow (mgd)	390	600	750	670	950	1000
STORM CONDITIONS						
Wastewater Flow (mgd)	390	600	750	670	950	1000
Storm Capacity (mgd)		550	510		320	270
Total Flow (mgd)		1150	1260		1270	1270

(Annual Average Flow is 480 mgd based on 4 months of high groundwater conditions and 8 months of low groundwater conditions.)

	Loads (1000 lbs/day)*	
	BOD	TSS
Average Day	570	515
Maximum Day	1140	1080
Maximum Three Days	855	824
Maximum Month	741	670
Maximum Day with Storm	1305	1480

*Does not include residual sidestream loads.

TABLE 2-2

EXISTING METAL LOADINGS
(lbs/day)

Constituent	Average Load	Standard Deviation
Antimony	10.8	2.3
Arsenic	6.0	1.9
Boron	1261.2	2443.4
Cadmium	7.1	2.7
Chromium	75.8	29.5
Copper	345.1	103.4
Cyanide, Total	53.9	13.9
Lead	49.9	21.8
Mercury	4.1	5.2
Molybdenum	17.1	10.4
Nickel	66.0	29.5
Selenium	35.2	33.2
Silver	15.5	3.8
Zinc	738.8	841.8

Note: Average Load represents the non-storm mean load at Deer Island plus the non-storm mean load at Nut Island. Loadings are based on influent values only, which are reported in Summary Memorandum FB20C, and are the result of sample collections at the headworks for Deer Island, and Deer and Nut Island Influents.

TABLE 2-3

EXISTING ABN LOADINGS
(lbs/day)

Constituent	Average Load	Standard Deviation
Phenol	54.0	27.1
Benzyl Alcohol	69.3	24.7
1, 2-Dichlorobenzene	65.1	23.3
2-Methylphenol	71.0	18.3
4-Methylphenol	61.2	23.2
Benzoic Acid	269.4	138.9
Naphthalene	45.3	28.4
2-Methylnaphthalene	49.6	26.7
2, 4, 5-Trichlorophenol	349.0	95.8
Dimethyl Phthalate	69.6	19.4
Diethyl Phthalate	57.1	24.5
N-Nitrosodiphenylamine (1)	69.3	19.7
Di-n-butyl Phthalate	57.9	25.9
Butylbenzyl Phthalate	54.0	24.1
Bis (2-ethylhexyl) Phthalate	67.8	20.0
Di-n-octyl Phthalate	57.0	21.4

Note: Average Load represents the non-storm mean load at Deer Island plus the non-storm mean load at Nut Island. Loadings are based on influent values only, which are reported in Summary Memorandum FB20C, and are the result of sample collections at the headworks for Deer Island and Deer and Nut Island Influents.

TABLE 2-4

EXISTING VOLATILE LOADINGS
(lbs/day)

Constituent	Average Load	Standard Deviation
Bromomethane	54.3	19.3
Methylene Chloride	104.7	75.3
Acetone	337.1	268.6
Carbon Disulfide	27.5	7.6
trans-1,2-Dichloroethene	25.6	7.8
Chloroform	17.6	8.1
2-Butanone	82.5	43.8
1,1,1-Trichloroethane	41.8	17.9
Trichloroethene	36.2	19.2
Benzene	12.5	2.3
4-Methyl-2-Pentanone	64.7	23.7
Tetrachloroethene	47.4	27.8
1,1,2,2-Tetrachloroethane	29.4	6.4
Toluene	60.8	38.1
Chlorobenzene	28.0	7.6
Ethylbenzene	28.8	13.0
Styrene	30.1	7.3
Total Xylene; M, O, and P	85.9	59.4

Note: Average Load represents the non-storm mean load at Deer Island plus the non-storm mean load at Nut Island. Loadings are based on influent values only, which are reported in Summary Memorandum FB20C, and are the result of sample collections at the headworks for Deer Island and Deer and Nut Island Influents.

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Section 3

3.0 TREATMENT PLANT

3.1 PLANT PERFORMANCE

The treatment plant performance and its effluent quality can be described in terms of the two general categories used to describe the treatment plant loading: conventional pollutants and non-conventional pollutants. BOD and TSS are the parameters commonly analyzed to determine plant performance. The required removal efficiency for conventional pollutants is defined by the National Pollutant Discharge Elimination System (NPDES) permit as that required to meet national standards for secondary treatment. Desired removal efficiencies for conventional parameters establish the sizing of primary and secondary facilities. Once a degree of primary and secondary treatment is established, removals of the non-conventional pollutants can be estimated. Levels of removal of the non-conventional pollutants are not significantly controllable in primary and secondary treatment units.

The discharge permit recognizes that there is inherent variability in the day-to-day loadings and operation of secondary treatment facilities. Thus, permit limits are specified in terms of concentration and time. MWRA's NPDES permit for secondary treatment has specified that the discharge must contain no more than 30 milligrams per liter (mg/l) BOD or TSS on a monthly average basis, not more than 45 mg/l of either pollutant on a weekly average basis, and not more than 50 mg/l of either pollutant on a daily basis.

The secondary portion of the Deer Island treatment plant has been sized to treat flows up to a rate of 1080 mgd. Flow in excess of this, up to the total plant capacity of 1270 mgd, would receive primary treatment and be mixed, after screening to remove floatables, with the secondary effluent for subsequent disinfection and discharge to the outfall. The BOD and TSS concentration of the mixed effluent will meet required secondary discharge limits. Average annual effluent from the proposed secondary treatment plant is expected to be 15 mg/l BOD and TSS.

The NPDES permit also requires a minimum of 85 percent removal of both BOD and TSS based on monthly average values. This requirement may not be met under all circumstances. During high groundwater conditions, when the incoming wastewater is diluted, the projected monthly percent removals are estimated to be about 77 to 79 percent. Higher levels are not achievable without going beyond secondary treatment. The EPA's national policy allows for adjustment of the percent removal requirement provided that the effluent concentration limitations are met and that the dilution is not the result of excessive infiltration/inflow as defined by EPA rules and regulations. The MWRA's existing infiltration/inflow policy and program are focused on the EPA rules and regulations related to the elimination of excessive flows.

Removal rates for the non-conventional pollutants were estimated based on typical removal rates for metals and volatile organics at other secondary treatment plants. The volatile organics are removed at rates of 90 percent or greater in secondary treatment facilities. Projected removal efficiencies for fourteen metals detected in the MWRA raw wastewater vary from 5 percent for boron to 90 percent for silver. Typically, the efficiency of metals removal ranges from 50 to 75 percent, although the rate is quite variable for various metals.

3.2 EVALUATION OF ALTERNATIVE UNIT PROCESSES

Alternative unit processes for preliminary, primary, and secondary treatment as well as effluent disinfection were evaluated in a three-step process. The initial step consisted of a screening and preliminary evaluation of a wide range of alternatives. From this screening, a limited number of alternatives were retained for a detailed evaluation. Finally, recommended treatment facilities were selected, based on the detailed evaluation.

3.2.1 SCREENING AND PRELIMINARY EVALUATION OF ALTERNATIVES

Thirty-five unit processes were initially identified as potentially viable for either preliminary, primary, secondary, or disinfection treatment alternatives. The processes were selected after considering a wide range of conventional and state-of-the-art treatment alternatives. The processes identified were considered viable for initial preliminary evaluation and screening because of a demonstrated ability at large wastewater treatment plants to consistently meet treatment standards, and/or the flexibility to operate in various treatment modes under different hydraulic and loading conditions. Each unit process was evaluated on the basis of area requirements, operating history and performance at other large municipal wastewater treatment plants, relative capital and operating costs, and fourteen other screening criteria related to construction, operational, and environmental considerations. The thirty-five individual unit processes evaluated during the preliminary evaluation and screening phase and the fifteen unit processes carried forward for detailed evaluation are presented in Table 3-1.

3.2.2 DETAILED EVALUATION OF ALTERNATIVES

Treatment processes retained from the screening evaluation for both the Deer Island secondary treatment facility and the Nut Island headworks were compared in a detailed evaluation using technical, environmental, institutional, and cost considerations. Site planning goals and mitigation commitments also influenced the selection of the recommended plan.

Nut Island

Preliminary Treatment. To protect the inter-island conveyance system and the South System pumping station to be constructed on Deer Island, preliminary treatment, consisting of screening and grit removal, for the South System flows will be provided at the new Nut Island headworks. Two alternate screening methods, climber screens and catenary screens, were evaluated; and two alternate grit removal methods, centrifugal grit and aerated grit, were analyzed. Climber screens are recommended for screening of influent wastewater at the new headworks, based on MWRA operational familiarity as well as operational and maintenance advantages over the catenary screen alternate. Centrifugal grit removal is recommended at Nut Island rather than aerated grit removal. Both types of grit removal are proven processes and the institutional impacts of each are nearly identical. However, the centrifugal grit removal alternative was selected because of lower capital and operating costs and reduced volume of air

TABLE 3-1
SUMMARY OF SCREENING EVALUATION

UNIT PROCESSES EVALUATED	UNIT PROCESSES RETAINED FOR DETAILED ANALYSIS
PRELIMINARY TREATMENT	
Climber Bar Screens	Climber Bar Screens
Catenary Bar Screens	Catenary Bar Screens
Horizontal Flow Grit Channel	
Aerated Grit Chamber	Aerated Grit Chamber
Centrifugal Grit Chamber	Centrifugal Grit Chamber
Cyclone Primary Sludge Degritting	
Preaeration	
PRIMARY TREATMENT	
Rectangular Clarifiers	Rectangular Clarifiers
Circular Clarifiers	
Sedimentation with Chemical Addition	
Tray Clarifiers	
Stacked Clarifiers	Stacked Clarifiers
Inclined Tube Settlers	
SECONDARY TREATMENT	
Air Activated Sludge	Air Activated Sludge
Oxygen Activated Sludge	Oxygen Activated Sludge
Burns-McDonnell Treatment System	
Powdered Activated Carbon	
Deep Shaft Activated Sludge	
Sequencing Batch Reactor	
Rotating Biological Contactor	
Trickling Filter	
Biological Filtration	
Coupled System	Coupled System
Pulsed-Bed Filtration	
Physical-Chemical Treatment	
Rectangular Clarifiers	Rectangular Clarifiers
Circular Clarifiers	
High Rate Clarifiers Followed by Filtration or Microscreens	
Tray Clarifiers	
Stacked Clarifiers	Stacked Clarifiers
Screening (for primary effluent)	Screening (for primary effluent)
DISINFECTION	
Liquid Chlorine	
Soldium Hypochlorite	Sodium Hypochlorite (purchased on-site or off-site generation)
Ozone	Ozone (only with oxygen activated sludge.)
Ultraviolet Irradiation	Ultraviolet Irradiation

flow requiring air emissions control. Capital costs for the centrifugal system are 60 percent of the capital costs for the aerated grit removal system, and operating and maintenance costs for the centrifugal units are 80 percent of the O & M costs for the aerated grit units.

Deer Island

Main Pumping Station. The existing Main Pumping Station at Deer Island will require modifications in order to pump flow from the North Metropolitan Relief tunnel and the Boston Main Drainage Tunnel to the new treatment facilities. The major changes include replacement or modification of all ten pump units, including electric motor and variable speed drives and the addition of new knife gate valves on the suction of five pumps and on the discharge of all ten pumps.

Two 11.5-ft-diameter force mains will be constructed to convey wastewater from the North Main Pumping Station and Winthrop Terminal to the North System grit facilities.

Preliminary Treatment. The grit and screening removal equipment at the three existing North System remote headworks, currently being upgraded as part of the Fast-Track Improvements Program, will adequately protect the conveyance system and raw wastewater pumps throughout the planning period. However, as evidenced by grit buildup at the existing Deer Island plant, additional grit removal is required to protect the new treatment facilities. This additional grit removal for the North System flows will be provided by new grit facilities on Deer Island operating in series with the existing remote facilities. As with the Nut Island preliminary treatment facilities, centrifugal grit removal is also recommended for the new Deer Island grit removal facilities.

Primary Treatment. The factors of primary concern in the selection of the recommended plan for Deer Island were unit process area requirements and site layout, together with operational reliability and flexibility. During the detailed evaluation phase, a concurrent review of the alternative unit processes, the site constraints, and the site planning objectives immediately revealed that minimizing the area required for each unit process was imperative. The most feasible and accommodating process option available to meet this requirement was the use of stacked rectangular clarifiers for both primary and secondary sedimentation.

Preliminary site layouts of the treatment plant on Deer Island indicated that the use of conventional rectangular clarifiers was not a viable alternative for either the primary or secondary treatment systems. The use of conventional, rectangular units would require commitment of the entire Deer Island site for process basins and would not allow space for separation berms, plant roadways, control buildings, and other ancillary facilities. Therefore, the use of stacked rectangular clarifiers was the only alternative considered for both primary and secondary treatment.

To date, stacked rectangular clarifiers have not been used in the United States. However, various configurations of the units have been used in both primary and secondary treatment applications in Japan for over a decade. Over 37 Japanese plants now use them, including 8

plants with an average flow over 100 mgd. The Japanese installations produce effluents equal to or better than the conventional rectangular clarifier units.

Secondary Treatment. The three alternatives evaluated for secondary treatment -- air activated sludge, oxygen activated sludge and the coupled system (packed tower followed by activated sludge) -- have similar capital, operating, and life cycle costs. Of the three alternatives, the coupled system has the greatest capital costs, operation costs, and power consumption.

The three alternatives can be considered equal regarding potential noise impacts on neighboring homes, constructibility, effluent quality, and residual quantity and quality. The air and oxygen activated sludge systems can be considered equal with regard to area requirements, while the coupled system is slightly more area-intensive.

Operationally, the coupled system is slightly more complex, as the process requires control of two biological systems. The coupled system offered no distinct advantage over the activated sludge alternatives, and since it also had the highest costs and power consumption, it was eliminated from further consideration during the detailed evaluation of alternatives.

Thus, the activated sludge process utilizing stacked, rectangular clarifiers was selected for the secondary treatment component of the Deer Island treatment facilities. Alternative methods of providing oxygen to support biological stabilization in the activated sludge process were evaluated. Oxygen can be provided by air, or it can be generated on-site in a cryogenic oxygen generation unit. Either air or oxygen activated sludge would produce the desired plant performance.

The secondary treatment plant at Deer Island will be subjected to highly variable flows and loads due to the nature of the MWRA collection system. The ability to successfully maintain effluent quality under these variable conditions was an important parameter in selecting between air and oxygen for the activated sludge process. Oxygen activated sludge systems have an inherently greater capability to handle large variations in loadings than do air activated sludge systems. Operating oxygen activated sludge systems handling large variations in organic loads, flows, and chloride concentrations have demonstrated operating resiliency and considerable ability to maintain effluent quality. Oxygen systems have a proven track record in successfully handling large variations in organic loadings and have a clear advantage over air systems in this regard.

Additionally, there is significantly less process equipment and fewer components associated with the oxygen activated sludge system than are needed for the air activated sludge system. Most importantly, the air activated sludge system would contain over 100,000 fine bubble diffusers to entrain air into the wastewater. The success of the air activated sludge process is critically dependent on monitoring and maintaining the efficiency of these fine bubble diffusers. Monitoring and maintenance would be highly problematic with the covered aeration basins required to comply with air quality regulations at the new Deer Island secondary treatment facilities. Any maintenance on the fine bubble air diffusers and associated piping would require operator entrance into the covered basins. In contrast, the oxygen system utilizes mechanical aerators that can be maintained from the top of the covered oxygen basins

by lifting the aerators with a mobile crane. Oxygen system operators report that maintenance personnel are seldom, if ever, required to enter the covered oxygen basins. The MWRA Secondary Treatment Facilities Plan Operations Review Committee unanimously agreed that, with covered aeration basins, an oxygen activated sludge system would be preferred over air activated sludge.

All of the off-gases from the activated sludge process must be collected and treated to reduce odors, VOCs and other pollutants of public health concern. The collection and treatment of these gases is much more easily achieved in the oxygen activated sludge system than in the air system as the small quantities of off-gases from an oxygen system create an ideal situation for the application of emission treatment and control. Peak and average air flows for the air system are 280,000 scfm and 120,000 scfm, respectively. Corresponding values for the oxygen system are 6,000 and 3,000 scfm. Air emissions standards, particularly for air toxics, are in a state of flux. The oxygen activated sludge alternative, which generates only 2 percent of the vent air produced by air activated sludge, requires the least amount of control and offers significant advantages over the air system.

Given the level of equipment that must be maintained in each system, the operational complexity associated with the covered aeration basins in the air activated sludge system, the superior operational flexibility and reliability offered by the oxygen system, as well as air emmissions requirements, the oxygen activated sludge system is preferred from an overall operability standpoint.

During the detailed evaluation phase, the use of an anaerobic selector basin, prior to the aeration basin, was also evaluated for both the air and oxygen activated sludge alternatives. For both alternates the anaerobic selector is expected to provide added stability and reliability under varying loading conditions and produces a better settling sludge, allowing for a decrease in secondary clarifier sizing.

Based on the above, pure oxygen activated sludge, using cryogenic generation of the oxygen, with stacked, rectangular secondary clarifiers, is the recommended secondary component of the Deer Island treatment facilities. This selection was based on the ability of oxygen to efficiently treat highly variable loads without process upset, as well as its overall operability and lower air emission control requirements. An anaerobic selector, employed prior to the oxygen aeration basins, is recommended as part of the secondary treatment components. The benefits associated with the selector, including increased stability under varying loading rates, and a potential reduction in overall oxygen requirements and improved sludge settleability, warrant its inclusion.

Disinfection. The alternatives evaluated for disinfecting the Deer Island effluent were sodium hypochlorite (purchased or generated on-site), ozone, and ultraviolet irradiation. Dechlorination with either sulfur dioxide or sodium bisulfite was included with the hypochlorite alternatives. Between the start-up of the primary facilities and the start-up of the secondary facilities, effective disinfection of primary effluent is required. Sodium hypochlorite is the only alternative which would provide adequate disinfection under these circumstances. Therefore, to implement ozone or ultraviolet irradiation as a disinfectant

would require an interim sodium hypochlorite disinfection process between the start-up of primary and secondary facilities. Ozone is a questionable disinfectant for secondary effluents which exceed 30 mg/l TSS and BOD, such as those effluents that occur during maximum flow conditions at Deer Island. Ozone was eliminated from further consideration on the basis of this factor as well as its failure to offer any cost advantages.

Purchased sodium hypochlorite is preferred over ultraviolet irradiation even if subsequent water quality determination indicates that dechlorination procedures are required. The selection was primarily based on the present worth analysis which determined the present worth cost of the UV system to be 1.4 times the cost of the sodium hypochlorite system. A comparison of the sodium hypochlorite alternatives - purchase versus on-site generation - indicated that purchased sodium hypochlorite was a much more desirable alternative due to capital cost, operability, and power and staffing requirements.

The recommended plan for disinfection is to use purchased sodium hypochlorite and if dechlorination is necessary, to use sodium metabisulfite.

Control of Air Emissions

The emissions of odor-causing compounds, volatile organic compounds, and other pollutants of public health concern from the proposed treatment facilities are controlled under federal, state, and local regulations. The control of odors was addressed as a required mitigation measure in the Secretary's Certificate on the Siting EIR. The mitigation standard requires that there be no detectable odor when one part ambient air is diluted in one part of odor-free air at the property line of the treatment plant. This requires the Authority to design the new treatment facilities to eliminate off-site odors.

The Massachusetts Air Pollution Control Regulations require that all new or modified sources of air pollutants apply the Best Available Control Technology (BACT) to control volatile organic compounds (VOC) discharges. BACT is not specifically defined, but requires a case-by-case assessment taking into account energy, environmental, and economic impacts.

A modification to a source currently emitting more than 100 tons per year of VOCs must meet Lowest Achievable Emission Rate (LAER) requirements if it is determined that, after the application of BACT, the proposed increase above the baseline condition would be greater than or equal to 40 tons per year. Since the Boston area does not meet the National Ambient Air Quality Standards (NAAQS) for ozone, any emission increase above the baseline after LAER control would also have to be offset by obtaining an equal reduction, plus an additional ten percent reduction, in the level of VOC emissions from an existing source.

Emission of individual constituents with public health significance are limited by the Allowable Ambient Levels (AAL) standards set by the Department of Environmental Quality Engineering (DEQE). Pollutants of public health concern include about 150 compounds from EPA's Priority Pollutant List (PPL) and Hazardous Substance List (HSL). The AALs developed by DEQE for these pollutants represent the maximum allowable 24-hour incremental ambient impacts from proposed facilities. Compliance with the AALs requires that the calculated ambient increase in

concentration be less than the AAL at all locations of public access beyond the fence line of the treatment facilities.

Odor-causing compounds, VOCs and PPL/HSL pollutants can be emitted from treatment process units wherever interfaces exist between the wastewater and air. These interfaces exist at tank surfaces, channels, weirs, and aeration tanks. Recommended treatment facilities which have the potential to emit these pollutants in sufficient amounts to impact ambient air levels include the:

- Grit Removal Facilities
- Primary and Secondary Splitter Boxes
- Primary Clarifiers
- Anaerobic Selectors
- Aeration Basins
- Secondary Clarifiers
- Disinfection Basins

Emissions from these process units were estimated and used in air-quality modeling to assess the impact on ambient air quality. The first analysis considered odor-causing compounds and VOCs. The effectiveness of air emission control on PPL/HSL pollutants was then determined.

Both the existing Deer Island and Nut Island Treatment Plants emit in excess of 100 tons per year of VOCs. In order to prevent the uncontrolled release of air pollutants, the proposed treatment facilities will include covers. VOC emission estimates indicated that all tanks up to and including the aeration basins should be covered. Covers are not required on the secondary clarifiers and the disinfection basins. Air from the covered facilities will be collected and conveyed to odor/VOC control systems prior to discharge to the atmosphere.

A comparison of BACT controlled emission rates to existing annual VOC emissions resulted in net reductions for both the Deer and Nut Island baseline levels indicating that BACT levels of emission control, not LAER levels, are required.

Alternative systems evaluated for emission control included ozonation, wet scrubbing using caustic soda and hypochlorite, carbon adsorption, and fume incineration. Of these, the most reliable control system for both odors and VOCs is wet scrubbing followed by carbon adsorption. Wet scrubbing would be used to remove odor-causing compounds and carbon adsorption would be used to remove residual hydrogen sulfide and VOCs. Overall, removal efficiency for the system is estimated to be 95 to 99 percent for sulfide and 85 percent for VOCs.

Air quality modeling of the potential emissions from the recommended facilities indicated that the constituents released from the treatment system after emission control will be much less than the critical AAL levels measured at the boundaries of Deer Island. The recommended facilities will have insignificant impacts on the local populations in terms of ambient air quality. Recommended covers and emission control systems result in impacts on surrounding populations that are within allowable air quality limitations even under worst-case scenarios. No odors associated with the liquid wastewater treatment facilities will be detected off-site.

The recommended emission control systems are in full compliance with the provisions of BACT as required by the DEQE.

3.3 RECOMMENDED PLAN

3.3.1 TREATMENT FACILITIES

The recommended plan for the MWRA treatment facilities consists of the following major components:

Preliminary Treatment

- o Screening and grit removal at existing North System remote headworks.
- o Screening at Winthrop Terminal.
- o Additional grit removal of North System flow at new grit facilities on Deer Island.
- o Screening and grit removal of South System flow at new Nut Island headworks.

Wastewater Pumping

- o Replacement and modification of existing pumps at the North Main Pumping Station and the Winthrop Terminal to allow discharge to the new treatment facilities.
- o Pumping of the South System flow at a new South System Pumping Station on Deer Island.

Primary and Secondary Treatment

- o Primary treatment to a flow rate of 1270 mgd in stacked rectangular clarifiers arranged in four batteries.
- o Secondary treatment using the oxygen activated sludge process consisting of four parallel batteries of sequentially arranged anaerobic selectors, aeration basins and stacked rectangular clarifiers. The maximum flow rate in secondary treatment is 1080 mgd.
- o Oxygen generation with two 300 ton per day cryogenic units.
- o Fine screening of primary effluent in excess of 1080 mgd with traveling water screens.

Disinfection

- o Disinfection in chlorine contact basins with barge-delivered sodium hypochlorite followed by dechlorination, if required, with sodium metabisulfite.

The sequence of treatment is presented schematically in Figure 3-1.

All of the treatment units except the secondary clarifiers and disinfection contact basins will be covered. Exhaust air from the covered treatment units, and from pumping station wet wells and wet shafts, will be collected and treated with wet scrubbers (using sodium hypochlorite and caustic soda) followed by carbon adsorption.

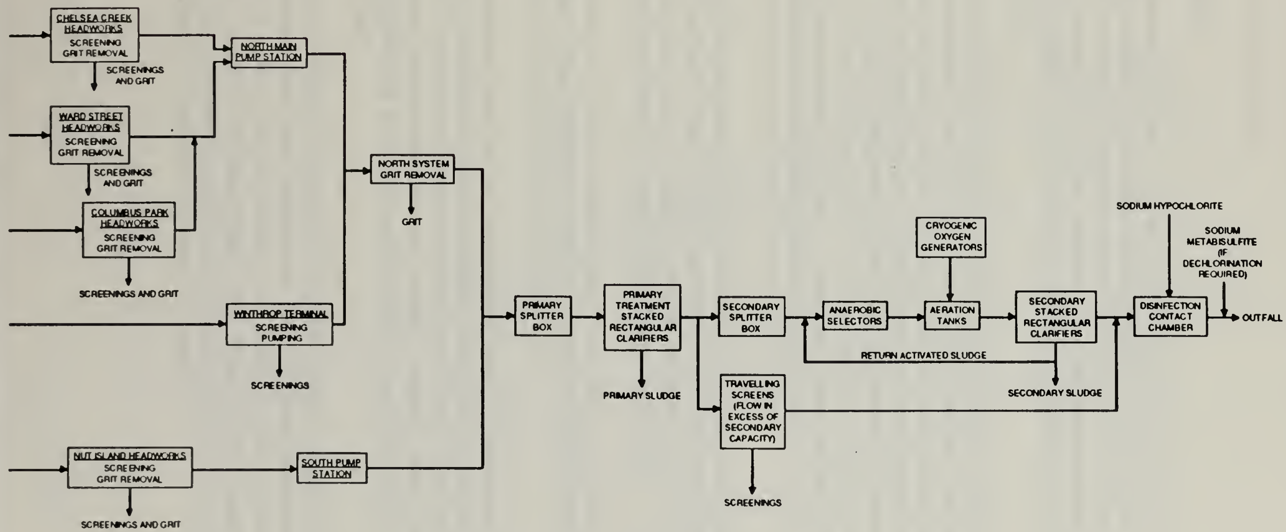

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FIGURE 3-1
RECOMMENDED MWRA TREATMENT FACILITIES SCHEMATIC

3.3.2 SITE LAYOUTS

Nut Island

The recommended layout for the new Nut Island headworks locates the facility at the site presently occupied by the existing anaerobic digesters. The site will be available once the MWRA's interim solids disposal program is in place by 1991. Operation of the existing Nut Island treatment facility will be maintained throughout construction and start-up of the headworks facility. Decommissioning of the plant will commence once the headworks is operational.

The headworks facility consists of a headworks building and grit removal facilities. The most visible component of the facility will be the headworks building which houses the screening facilities, truck loading bays, air emissions control facilities, administrative, operation, employee and maintenance areas. This building covers approximately 19,000 ft^2 and is 20 ft high. The existing grade at the selected site is approximately 131 ft while the final grade at the site will be approximately 128 ft. The grit chambers are located below grade, adjacent to the headworks building, and cover an overall area of approximately 22,000 ft^2. The inter-island tunnel shaft is located adjacent to the grit chambers. Construction of the shaft will not interrupt the operation of the existing plant.

Access to the headworks facility is by either the existing main access road along the western side of the island, or the pier to be constructed at the northeast end of the island. The roadways on the island are arranged to provide safe traffic patterns for all vehicles, and allow fluid movement of the trucks serving the headworks facility.

The site plan for Nut Island allows for safe, shared use for wastewater treatment and passive recreation. Areas designated for wastewater treatment facilities are separated from the remainder of the island by fences and earth berms.

The portions of the site that have not been designated for wastewater treatment purposes are planned as open space for passive recreation. Landforms and vegetation on the island promote this use. This concept is consistent with the City of Quincy's land use zoning classification. A pedestrian path encircles the island, providing continuous views of Boston Harbor and Quincy and Hingham Bays, as well as convenient access to most of the island including the beach on the eastern shore.

Proposed landscaping on the island is functional, while at the same time creating a natural visual image. Earth berms up to elevation 140 ft are formed around and against the wall of the headworks building and grit chambers. The berms, trees and shrubs are arranged to visually screen the headworks facilities, primarily from Hough's Neck, but also from points across Quincy Bay and from the pedestrian path encircling the island. An architectural site plan of the developed Nut Island site is presented in Figure 3-2.

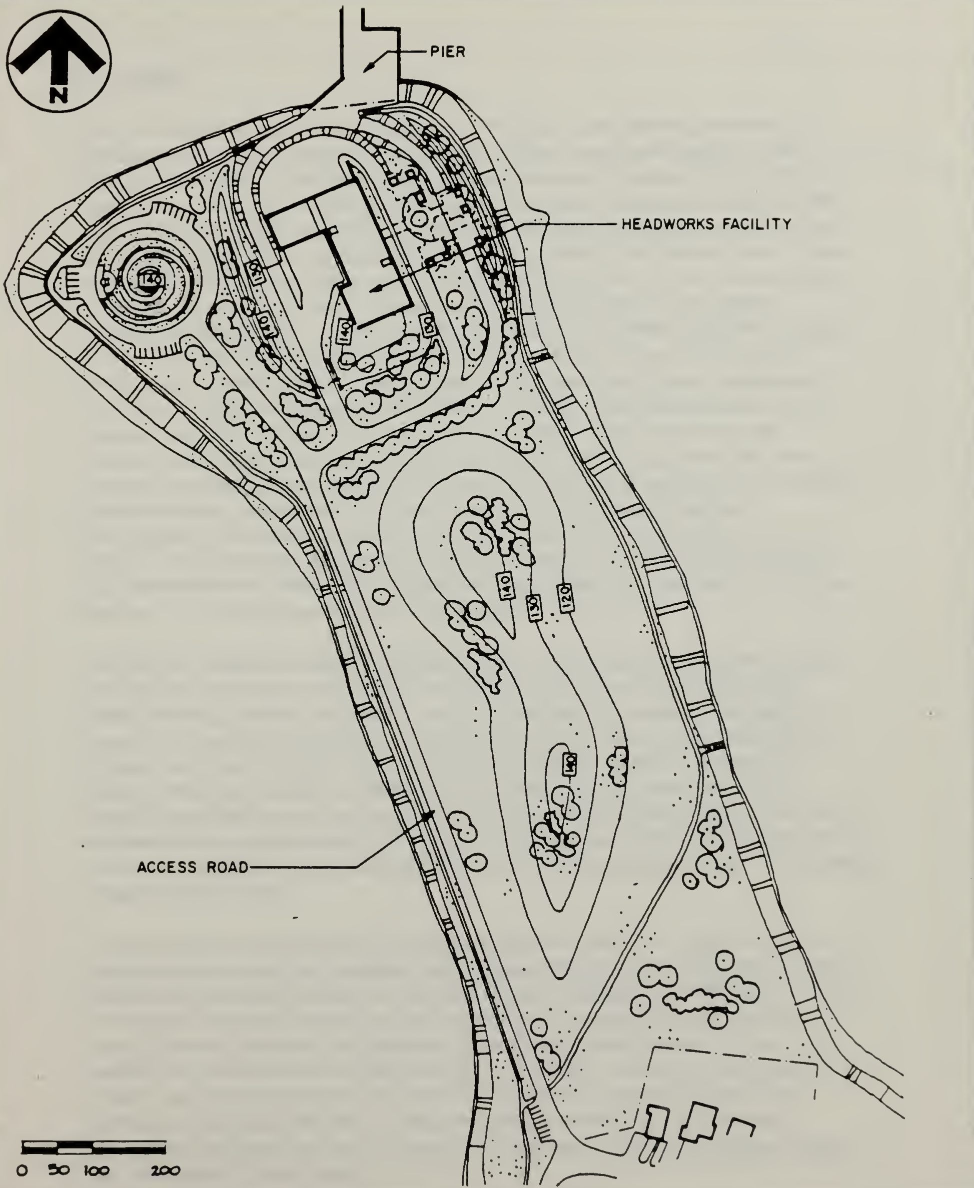

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FIGURE 3-2
NUT ISLAND SITE PLAN

Deer Island

The Deer Island site plan consists of four interrelated parts - the buffering landforms, the treatment facilities, the support facilities, and the residual management facilities. These parts are tied together by an external access system consisting of roadways, piers, and service roads and an internal access system consisting of passageways, pipe galleries, and stairwells. Each of the parts has its own distinct visual image - the landforms are gently sloped earthen and vegetated hills, and the treatment facilities are large massings of concrete basins. These parts have been assembled so that the concrete treatment facilities occupy the central portion of the site, the brick faced support facilities occupy the adjacent area on the western, southern and eastern side of the treatment facilities, and the landforms occupy the outermost portion of the site and effectively conceal the treatment facilities and support facilities on the northern, eastern and western sides of the site. The appearance of the recommended facilities to a viewer will depend upon the viewer's location. Within the landform areas on the outer edge of the site, the visual image will generally be of the earthen vegetated hillsides. This image will also be seen by distant viewers, particularly those to the north and east of the site. The view from the external access roadway located between the western landforms and the treatment facilities will be of the brick faced support facilities backdropped by the concrete walls of the basins, with earth landforms rising around the horizon. From the treatment facilities, the view will consist of a large expanse of covered and uncovered basins surrounded by support buildings which are backdropped by the earthen landforms. The recommended site layout is shown in Figure 3-3.

Vertically, the design of the site is organized around two distinct zones. The lower/access zone is at an approximate elevation of 120 to 130 ft and is the level at which the piers, access roadways, internal passageways, and the ground floor of the support buildings are located. The upper/facilities zone at elevations 145 to 155 ft is the level at which the tops of basins, air emission control facilities, operation buildings, and service roadways are located. Within the facilities, air emission exhaust stacks, potable water storage tank, oxygen plant distillation columns, and power plant exhaust stacks create vertical spikes rising to elevations between approximately 200 to 230 ft. Around the facilities the landforms rise to elevations ranging from approximately 180 to 220 ft and are connected by ridges with elevations of approximately 150 ft.

The main process area of the liquid treatment facilities is aligned in a rectangular grid on a generally south-to-north axis, extending from approximately the southern edge of the existing drumlin and proceeding northward to the area currently occupied by the Hill Prison structure. The southern portion of the main process area consists of primary treatment facilities, the central portion is dedicated to the anaerobic selector basins and the aeration basins, and the northern end consists of the secondary clarifiers. The plant is subdivided within each of the primary and secondary treatment areas into four equal sized batteries, with each of the batteries containing multiple basins. Residuals handling facilities (per the Residuals Management Facilities Plan) will be located in the area between the liquid treatment facilities and the southern tip of the island.

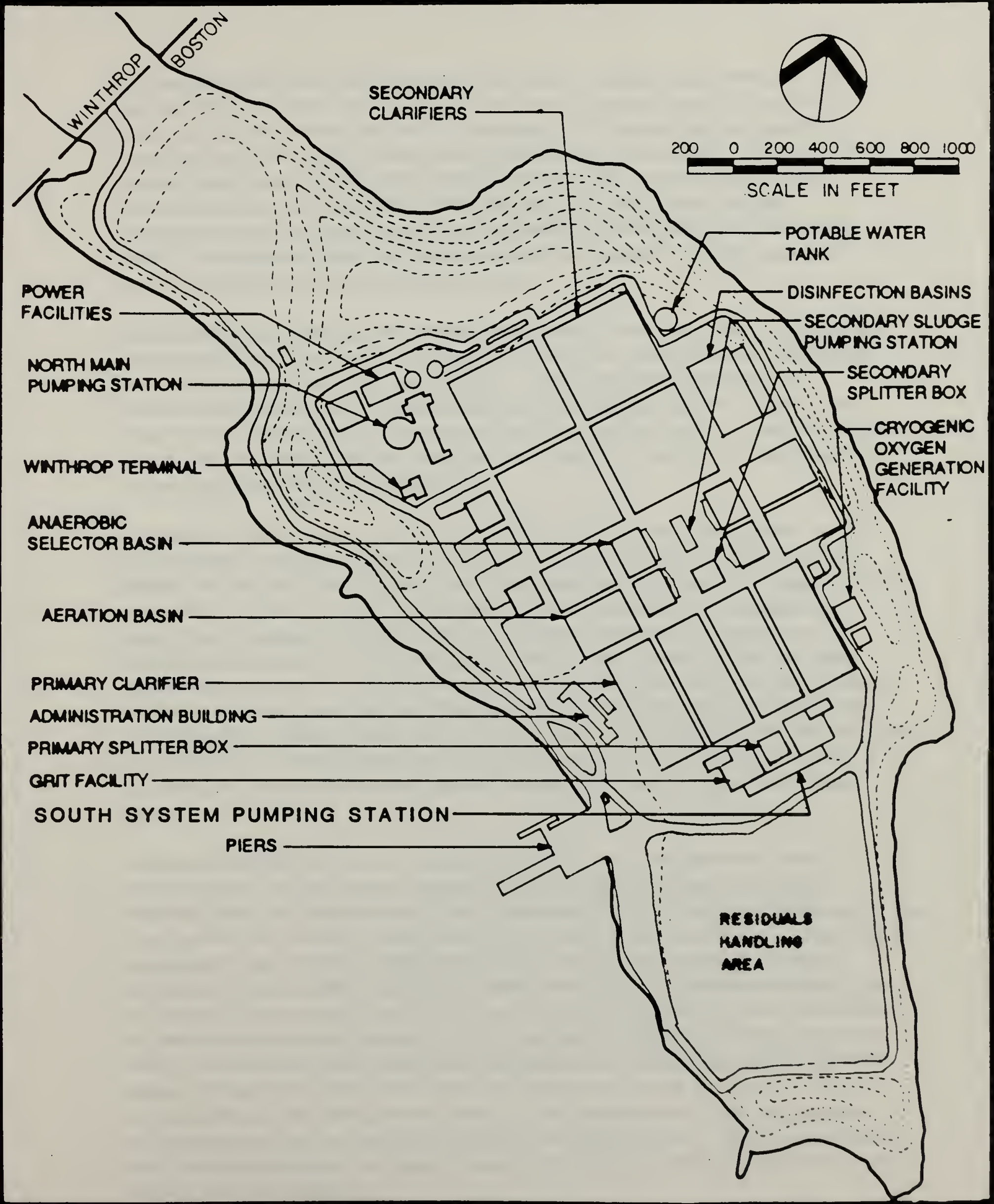

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FIGURE 3-3
RECOMMENDED DEER ISLAND FACILITIES

The support facilities have been located along the western, southern and eastern side of the plan as independent, brick faced structures with either connecting tunnels, passageways, or bridges to the main treatment structure. The majority of the support facilities including the power facilities, North Main Pumping Station, maintenance, warehousing, administration and laboratory operations have been located along the western side of the treatment facilities. On the southern side of the treatment facilities have been located the primary facilities operations management center, the grit handling facilities, and the South System Pumping Station. On the eastern side of the treatment facilities are located the oxygen generation plant and the primary effluent screening structure.

Access to Deer Island will be both overwater and overland. Overwater traffic will unload and be controlled at the proposed new pier facilities. A vehicular access road along the western side of the treatment facility will connect the pier to the administration building, the treatment facility lower zone, maintenance facilities, and residual facilities. The vehicular access road will be ramped up to the northern end of the facilities, and on the western side at the maintenance buildings adjacent to the secondary clarifiers. The service roads completely surround and access the upper facilities zone.

An overland vehicular access road will connect Point Shirley to Deer Island. This road will have controlled access at two points. One of the control points will be a fenced gate at the property line, adjacent to Point Shirley and the northernmost outer berm. The second control point will be the entrance to the treatment facilities at the inner limit of the separation zone. This overland access roadway follows the western shoreline to the area of the administration building. This roadway alignment directs visitors from the overland access routes to the same common point, the administration building, as the overwater access routes. Within the separation zone, north and east of the plant, construction of a pedestrian footpath is contemplated. It would commence at the northern gate near the man-made drumlin and follow the northeastern shoreline of Deer Island to its southernmost tip. A control fence located at the inland foot of the landforms will prevent pedestrians from entering the treatment plant areas.

Within the treatment facilities are numerous pipe galleries that have been configured to provide the plant with the internal circulation system for the lower/access zone through connected passageways between the various process elements. The main internal passageway runs from the pier area northward through the treatment facility. Main east-west passageways run at right angles to the north-south passageways in three locations: the east-west passageway between the primary clarifiers and aeration basins connects to the administration building and the primary effluent screening building; the east-west passageway between the aeration basins and the secondary clarifiers connects the vehicle maintenance building, secondary operations center, return activated sludge pump station, and plant water pump station; and the east-west passageway between the batteries of secondary clarifiers connects the maintenance and parts storage facilities to the internal access system. Minor passageways and pipe galleries would be located between process batteries as necessary for equipment access. Egress and ventilation shafts from the passageways are typically located at the ends and midpoints of the primary and secondary clarifiers batteries.

3.3.3 PLANT UTILITIES

Power

No public electrical utility currently services the Deer Island wastewater treatment facility. All electrical energy required at Deer Island at present is generated on-site by five, 700 kw diesel engine driven generators. Additional diesel engine-driven generators are being installed as part of the fast-track improvements to meet present day demands and should be operational by 1988.

The estimated average electric power requirements for the various phases of construction and operation of the treatment facility are summarized below:

Year	Average Load (kw)
1990	14650
1991	18650
1995	24050
1999	36800

To meet these demands a combination of on-site generation and off-site supply from Boston Edison Company (BECo) were evaluated using technical, economic, and environmental evaluation criteria.

The recommendation to provide sufficient, reliable power to Deer Island in all phases of construction and operation consists of the installation of a temporary power supply cable, followed by the installation of two 115 kv feeder cables and a combined cycle power plant. A summary of the recommended power plan is as follows:

- Install a temporary power supply cable by 1990 or sooner. Provide 15 MW of immediate power through Massachusetts Electric Company (MECo) from its Metcalf Square Substation in Winthrop.

- Install a 115 kv permanent feeder from Boston Edison's K Street substation in South Boston, by January 1992. Placing the feeder in service requires the installation of a 115 kv to 13.8 kv substation on Deer Island.

- Install an on-island 25,700 kw combined cycle power plant by January 1995 to provide additional capacity for peak shaving and also to provide protection against catastrophic failure of the off-site power sources. This additional capacity, combined with the soon-to-be-installed fast-track capacity, will result in an installed on-site capacity of 37,700 kw.

- Install the second Boston Edison 115 kv permanent feeder by January 1995. This feeder will originate from BECo's Chelsea substation.

On-site sludge digestion and its associated costs and benefits are being studied as part of the Residuals Management Facilities Plan. On-site digestion would produce methane gas which can be used as a fuel in the on-site power generation facilities.

Heating Demand

The heating demand at the Deer Island treatment facilities will increase as new wastewater treatment facilities are constructed. The expected total yearly heat load, based on seasonal steam demand per degree days, has been estimated at approximately 86,000 million Btu.

Heat will be extracted as steam from the combined cycle power plant.

Potable Water and Plant Water System

Potable water needs for the new Deer Island wastewater treatment facilities were estimated and contrasted with existing water availability, and alternative approaches to support Deer Island's water supply needs were evaluated.

Potable water is presently used at the wastewater treatment facility for toilets, sinks, drinking fountains, sludge heaters, engine cooling, equipment flushing and washdown, and seal water. This water is supplied from the Winthrop water distribution system. Current average and maximum consumption rates are 0.1 mgd and 0.2 mgd, respectively. Water use will increase when the plant is upgraded to an average daily consumption of 1.0 mgd and a maximum daily consumption of 2.0 mgd.

Potable water required by the new Deer Island facilities cannot be supplied through Winthrop's existing distribution system due to the limitations in the system. A water supply study concluded that Deer Island potable water needs are best met by constructing a dedicated 20-in-diameter main through Winthrop to Deer Island.

The recommended plan provides for a 1.54 million gallon on-site storage of potable water at Deer Island in order to dampen the effects of diurnal flow-rate variations, to provide adequate pressure for firefighting, and to provide a source of water in the event of a break in the dedicated main.

In order to minimize the consumption of potable water, the recommended Deer Island facilities are designed to reuse primary and/or secondary effluent for those purposes which do not require potable quality water. Non-potable water is designated plant water, and will be used as necessary for engine cooling, process equipment flushing and equipment washdown. Plant water will be provided by a 45 mgd (31,250 gpm) plant water pumping station discharging directly to the plant water distribution system.

3.3.4 ENVIRONMENTAL CONSIDERATIONS

The environmental assessment of the treatment recommendations considers impacts on groundwater, air quality, land use and visual aspects, traffic, noise, terrestrial and aquatic ecology, and

historic and archaeological resources on both Deer Island and Nut Island.

Groundwater

Groundwater levels on Deer Island generally vary between elevations 108 and 114 ft. Since most construction activity at Deer Island and Nut Island will be well above groundwater levels, and since no future use of groundwater is proposed at the new facilities, no impacts on this resource are expected.

A secure landfill will be located in the southernmost landform on Deer Island and will provide for the disposal of the grit and screenings presently buried south of the central drumlin. The landfill design will comply with the DWPC criteria for "sludge only" landfills and will use a double liner and leachate collection system to provide permanent protection for the groundwater resource.

Air Quality

The applicable air quality standards for the Commonwealth of Massachusetts are the same as the National Ambient Air Quality Standards (NAAQS).

The air quality impacts of the power and pump stations on Deer Island indicate that the 1995 power generating configuration would improve air quality in the area for all pollutants, compared to existing emissions, with the exception of TSP, which would remain essentially the same.

The proposed treatment system incorporates covering the treatment process units through the aeration basins, and operation of air emission controls such that even under a worst-case scenario, the impacts will be within allowable air quality limitations at all locations which are accessible to the public. At the more easily accessible locations (neighborhood sites adjacent to the facility), the impacts have been determined to be insignificant.

Land Use and Visual Impacts

Deer Island

Construction and operation of the new wastewater treatment facility on Deer Island will change land use on those portions of the island currently used for activities other than wastewater treatment. Upon completion of the construction activities at the turn of the century, virtually the whole island will be dedicated to wastewater treatment. Existing facilities will have been demolished (with the exception of historic structures identified for preservation and reuse), and earth movement will significantly change the profile of the island. Earthen berms will serve to separate the treatment plant and the Town of Winthrop. A large area of open space on the neck of the island and a footpath located along the eastern edge of the island will be open for public access.

Upon completion of the facility and landscaping, the island will appear more natural from most viewing locations than it does at present.

Nut Island

The construction of the new headworks on Nut Island should significantly improve the compatibility of land use with abutting neighborhoods as well as provide a new area for passive recreational opportunities. The appearance of the site will be more natural, with landscaping and vegetation replacing the current concrete and asphalt surfaces.

Traffic

Transportation impacts in the town of Winthrop resulting from the construction of the Deer Island Treatment Facilities will be minimal. Although large numbers of workers and quantities of construction materials will be required, half of the workers will be transported by ferry and the remainder will be transported by buses, using satellite facilities. With the exception of contingency trucking, all materials and equipment will be transported to Deer Island by barge.

Transportation impacts at Nut Island are being addressed in the on-island Water Transportation Facilities Planning FEIR.

Noise

Deer Island

Operation Noise. The new wastewater treatment facility on Deer Island will include equipment such as pumps, compressors, motor drives, a gas turbine, and an oxygen generation system, which have the potential to create audible off-site noise. An analysis was performed to identify the significant potential contributors to off-site noise, to estimate their sound levels in Point Shirley, and to select the appropriate noise mitigation required to minimize operations noise impacts.

To evaluate noise impacts from the facility, ambient noise levels were measured to serve as evaluation criteria. The levels found were 39 dBA nighttime and 45 dBA daytime. The noise evaluations have indicated that no noticeable increases above these evaluation criteria will be experienced during facility operation.

A considerable amount of the equipment will require noise attenuation. However, with the implementation of noise mitigation, the total sound level contribution of the facility at the nearest neighbor during nighttime hours is expected to be approximately 36 dBA, 3 dBA lower than the minimum ambient sound levels measured in 1986. Under the most favorable noise propagating conditions, a less than 2 dBA increase in existing ambient sound levels will occur. This change in ambient sound levels will not be noticeable.

Construction Noise. The construction of the facility will continue over a period of approximately twelve years, 1988 to 1999. During that time numerous buildings, treatment facilities and earthen landforms will be constructed, and the existing plant and prison will be demolished. The greatest potential for noise impact at Point Shirley will occur during the early stages of construction with the movement and placement of the earthen landform at the northern end of Deer Island. Once constructed, this landform will serve to buffer the remainder of the construction noise.

The criteria of 39 dBA, nighttime, and 45 dBA, daytime, were also used to evaluate noise impacts from facility construction. Various mitigation strategies were employed to implement a noise control objective which would limit intrusive daytime construction noise to no more than 10 dBA over those ambient levels.

The most significant noise mitigating measure which will be utilized during construction is the placement of new landforms. The northern landform has been determined to be an effective noise barrier during construction, reducing noise perceived at Point Shirley by about 10 dBA for eighty-three percent of the daytime. Maximum construction noise at Point Shirley will be approximately 50 to 54 dBA during upwind and cross-wind conditions, when the noise barrier is most effective. Approximately 17 percent of the time, down-wind conditions limit the effectiveness of the noise barrier. Noise levels range between the low 50s to a maximum of 65 dBA under these worst-case conditions. Analysis of ambient noise monitoring data from Point Shirley has indicated that these projected, worst case impact noise levels are characteristic of the area and occur during 97 percent of the daytime for about six minutes each hour. The projected construction noise levels are similar in magnitude to the existing daytime median or L_{50} levels, which range from 47 dBA to 63 dBA.

Nut Island

Operation Noise. The new grit and screening facility at Nut Island will be completely enclosed, with expected sound levels of less than 25 dBA at the nearest residential area. Since the daytime and nightime minimum ambient sound levels have been reported at about 50 dBA and estimated at 30 to 35 dBA, respectively, operation noise at the screenings facility will not be audible at the nearest residential area.

Construction Noise. The primary construction activities on Nut Island consist of the demolition of the existing facility, site preparation, and construction of the new building. The construction sound level is expected to be 63 dBA from 1992 to mid-1995, dropping to 60 dBA for the remaining year of construction.

Terrestrial and Aquatic Ecology

Sources of potential impacts on fauna and flora associated with the construction effort include: habitat removal and the subsequent displacement of fauna from cleared areas; the generation of fugitive dust; increased potential for erosion of cleared surfaces; construction generated noise; and the movement of construction personnel, equipment and materials on-site.

Land clearing is expected to have an adverse impact on the habitat of local wildlife species. However, none of the faunal species are endangered, threatened, or otherwise unique. The post-construction repopulation of the species on Deer Island is expected; thus the loss of these individuals does not constitute an impact of consequence.

The existing flora, primarily grass, is fairly resistant to impacts from fugitive dust. Dust control will be implemented through the use of water spray trucks to dampen exposed surfaces. No impact of dust on vegetation in adjacent communities is expected.

Erosion will be controlled through temporary stabilization of graded areas with seeding, tacking or mulching until permanent cover is established. The construction mitigation program will ensure that runoff from exposed surfaces will drain to settling basins, holding ponds, hay bale barriers and/or silt fences prior to discharge to the harbor.

Since the areas surrounding the construction zones presently do not support an appreciable number of wildlife species, no long-term deleterious impact from construction-related noise and movement of personnel, equipment and supplies is anticipated.

Few if any negative impacts on the terrestrial and aquatic ecology are anticipated from the construction and operation of the headworks on Nut Island.

Historic and Archaeological Resources

No historical or archaeological resources have been identified on Nut Island.

Historical and archaeological resources on Deer Island consist of the following:

- Hill Prison
- Prison Superintendent's House
- Steam Pumping Station
- Farmhouse
- New Resthaven Cemetery

Consideration was given to potential preservation and reuse of these resources, compatible with the treatment facility site planning needs; impacts of site development on these resources; and proposed measures which would mitigate impacts on these resources.

The land requirements for the new secondary treatment facility use virtually all of the land on Deer Island and thus reduce the flexibility for planning reuse of historic structures.

Site planning evaluations have recommended that the Hill Prison and the Farmhouse be documented for the Historic American Building Survey and subsequently demolished. The Superintendent's House will be moved to a higher elevation and reused as a security center for the new treatment plant. The Steam Pumping Station, situated near the water where the proposed piers will be constructed, will be renovated and expanded for use as the administrative and laboratory

functions. The Resthaven Cemetery will be left intact: the addition of 30 to 40 ft of fill material to the surface of the Cemetery will provide a mitigating noise and visual barrier, and will act as an appropriate preservation for the Cemetery.

Section 4

4.0 INTER-ISLAND CONVEYANCE SYSTEM

4.1 INTRODUCTION

The consolidation of treatment of the North and South System flows at the new Deer Island Secondary Treatment Facility will require an inter-island conveyance system to transport a maximum of 360 mgd of South System flow from Nut Island to Deer Island, a distance of approximately five miles. Various construction methods, as well as the possible combination of construction methods, were investigated. The alternatives were evaluated and the recommended plan was selected based on technical adequacy, cost considerations, environmental impact, and institutional considerations.

4.2 DESCRIPTION OF ALTERNATIVES

The inter-island conveyance system could be constructed by any of three methods: marine pipeline, sunken tube, or deep rock tunnel.

A marine pipeline would be built by conventional marine construction methods. In deep water, barge-mounted equipment would be used to trench, lower and install sections of pipe in lengths of approximately 16 ft, and place backfill and stone cover protection as required. In shallow near-shore areas (surf zone), a stationary trestle supporting a traveling crane on rails would be constructed to perform the same duties as the barges.

The sunken tube method of construction has been successfully used on a number of underwater vehicular tunnels, particularly in the Chesapeake Bay area. This type of construction is considered potentially cost-effective for diameters over 12 ft, which is only slightly larger than that anticipated for the inter-island conduit. The tube would be fabricated from steel in lengths of approximately 200 ft. The tube would be outfitted with interior and exterior concrete, towed into position over an excavated trench, and sunk into the trench. Trench excavation, stone bedding, backfill, and cover protection would be similar to that performed for pipeline construction.

The deep rock tunnel alternative is also a conventional method of construction that has been used successfully in the Boston area and throughout the world. Vertical access shafts would be constructed on land at the beginning and at the end of the tunnel. These shafts would penetrate through the overburden and into sound rock, terminating approximately 200 to 300 ft below the surface. The tunnel would be excavated by a tunnel boring machine (TBM) or by drill and blast techniques, and lined with concrete.

4.3 EVALUATION OF ALTERNATIVES

The initial screening of alternatives revealed that there are limitations on the use of both the marine pipeline alternative and the sunken tube alternative for the inter-island conveyance system. The most important limitation is caused by the fact that the conduit must cross the main Boston shipping channel along the route from Nut Island to Deer Island. The crossing will be in President Roads. A large-diameter pipe or sunken tube extending across the shipping

channel is not practical for three reasons.

First, the water depths in the channel are 60 ft to 70 ft below mean low water. Due to burial and cover requirements to protect the pipe against potential damage from anchor dragging and scour from wave and tidal forces, the bottom of a pipeline trench would be approximately 80 ft to 90 ft below mean low water. Since the pipeline must slope continuously downward toward its terminus on Deer Island to prevent solids deposition, a pipeline trench across Deer Island would be well over 100 ft deep. This would place the lower 15 ft to 25 ft of the excavation into rock. The length of the trench would be over 2,000 ft. long. The depth of cut, length of trench, and required rock excavation make these alternatives undesirable.

Secondly, since all ship traffic to and from Boston passes through President Roads, major pipeline construction across this busy but narrow shipping lane would require careful coordination with the U.S. Coast Guard to avoid unsafe conditions during construction. Although this type of construction is possible, it is not desirable if alternative means are available.

Finally, although there are currently no plans to do so, it is conceivable that the shipping channel may be deepened during the project life or beyond. If this occurs, another conduit would have to be constructed.

For these reasons, the deep rock tunnel is the only method of construction considered feasible for crossing the Boston shipping channel. It would be possible, however, to construct a pipeline or sunken tube between Nut Island and Long Island with a deep rock tunnel from Long Island to Deer Island.

Based on this, the following three inter-island conduit alternatives were selected for detailed evaluation:

- Alternative 1 - A single deep rock, concrete-lined tunnel with vertical access shafts located on Nut Island and Deer Island.

- Alternative 2 - A single concrete marine pipeline from Nut Island to Long Island, and a single deep rock, concrete-lined tunnel from Long Island to Deer Island, with vertical access shafts on both Long Island and Deer Island.

- Alternative 3 - A single concrete-lined sunken tube from Nut Island to Long Island and a single deep rock, concrete-lined tunnel from Long Island to Deer Island, with vertical access shafts on Long Island and Deer Island.

As in the case of the treatment plant, the alternatives were evaluated based on environmental, technical, cost and institutional criteria. For every criterion considered in the evaluation, the deep rock tunnel is better than or equal to the other alternatives. The major advantages of the tunnel are least environmental impact and least cost. Tunnel construction results in

only 200,000 yd^3 of mostly rock spoil, which could be used as fill on Deer Island. Construction of either of the other alternatives would generate 1.6 million yd^3 of mostly unusable dredged spoils. The tunnel has virtually no impact on fish, shellfish, and other marine biota, whereas the other two alternatives will temporarily disrupt approximately 46 acres of benthic habitat due to the required dredging. Because of this dredging, a complex and lengthy permitting procedure could be expected. The estimated project cost of the tunnel is about 56 percent of the cost pipeline/tunnel alternate and 37 percent of the estimated cost of the tube/tunnel alternate.

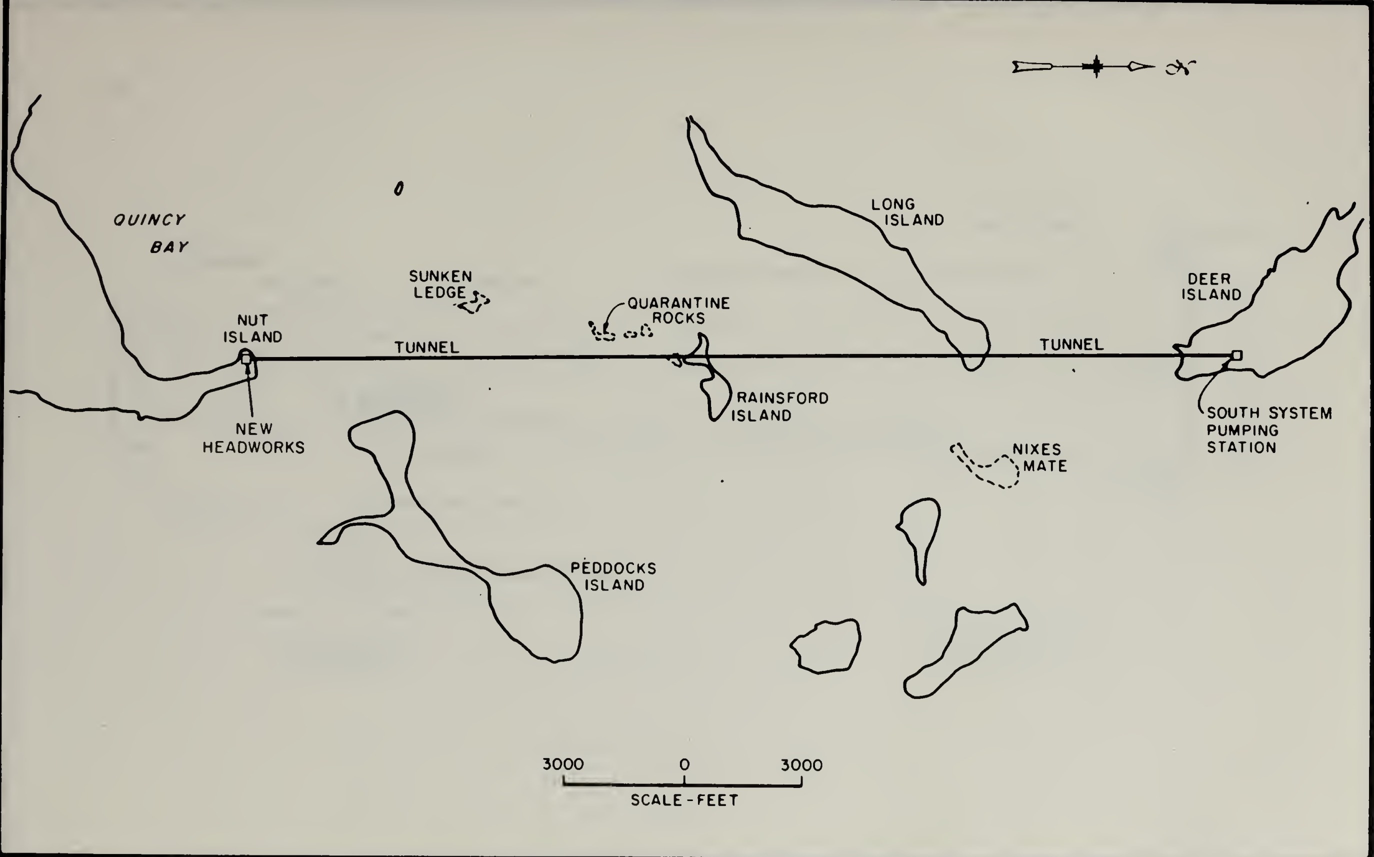
As noted earlier, a new South System pumping station, capable of pumping flows ranging from 80 mgd to 360 mgd, is also required. Although it was found to be technically feasible to locate the pumping station on either Nut Island or Deer Island, the Deer Island location was selected because the necessary pumping station support facilities will be constructed on Deer Island as part of the new wastewater treatment plant support facilities. The principal support facilities include redundant sources of electrical power, spare parts storage, and maintenance facilities. If the pumping stations were located at Nut Island, separate support facilities would have to be constructed, operated, and maintained.

4.4 RECOMMENDED PLAN

Based on the above evaluation, it is recommended that a deep rock, concrete-lined (either pre-cast concrete sections or cast-in-place concrete) tunnel connecting Nut Island and Deer Island be constructed with the South System pumping station located at Deer Island. The recommended inter-island conveyance system is shown in Figures 4-1 and 4-2. The tunnel, with a finished inside diameter of 11 ft, will be constructed in competent rock approximately 200 ft to 300 ft below sea level. The deep rock tunnel will be connected through vertical shafts at the new headworks at Nut Island and at the new South System pumping station on Deer Island. One vertical shaft will be located at each island. All wastewater passageways will be lined with concrete. The tunnel will follow a straight line from Nut Island to Deer Island, a distance of approximately 24,800 ft.

The recommended South System pumping station to be built on the southern side of Deer Island will include six pumps, each rated at 90 mgd. All pumps will be driven by an electric motor through a variable-speed eddy-current coupling drive. As indicated, the Deer Island location was selected because the necessary pumping station support facilities, such as redundant major sources of electric power, will be available on Deer Island. Eddy-current couplings were selected over variable-frequency drives because of their lower cost.

The environmental impact assessment of the recommended plan has identified the incremental effects on land and marine resources attributed directly to construction of the inter-island transport system during the 1991 through 1995 period. Overall, the recommended plan for the inter-island conveyance system will have only the following minor effects on land and marine resources:



MASSACHUSETTS WATER RESOURCES AUTHORITY

FIGURE 4-1
TUNNEL PLAN

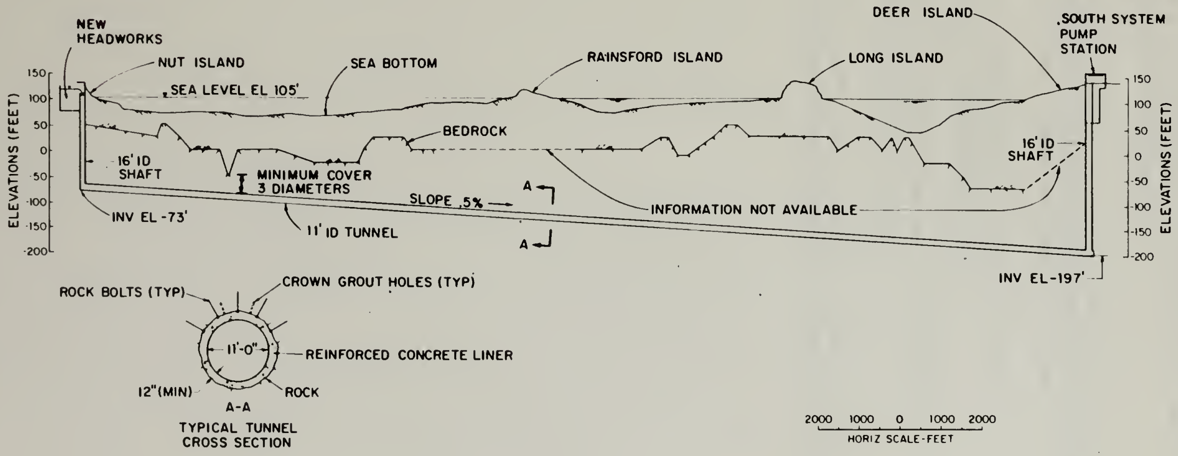


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FIGURE 4-2
TUNNEL SECTION

- Continuous off-site construction noise levels predicted for the nearest residents at Point Shirley (Winthrop) and Great Hill (Hough's Neck) are approximately 10 dBA above existing ambient daytime noise.

- There are essentially no impacts on marine resources because no marine construction is required for the recommended tunnel alternative and all tunnel spoils will be used on Deer Island to construct landforms for visual and noise barriers.

- The pumping stations and vertical access shafts are not located in proximity to any historical or archaeological resources.

- There are no effects on current or future potential for recreational opportunities on either Deer Island or Nut Island.

- Impacts on terrestrial ecology will be minimal, considering the lack of any unique existing resources and the ongoing construction activities in the affected areas.

Section 5

5.0 EFFLUENT OUTFALL

5.1 INTRODUCTION

Over the past year, studies have been conducted to determine the optimal location for the effluent discharge from the new Deer Island plant. These studies included investigations of the potential impacts of the construction and operation of the outfall, as well as investigations of alternative methods of constructing these facilities.

In addition, a continuing dialogue has occurred among the MWRA, the regulatory agencies, and various citizens' groups to define relevant criteria which can be used to select an appropriate, acceptable outfall terminus. Twenty-eight different criteria were selected, and were categorized into four broad areas: Environmental, Technical, Cost, and Institutional. These criteria form the framework for the analyses that led to the recommended location.

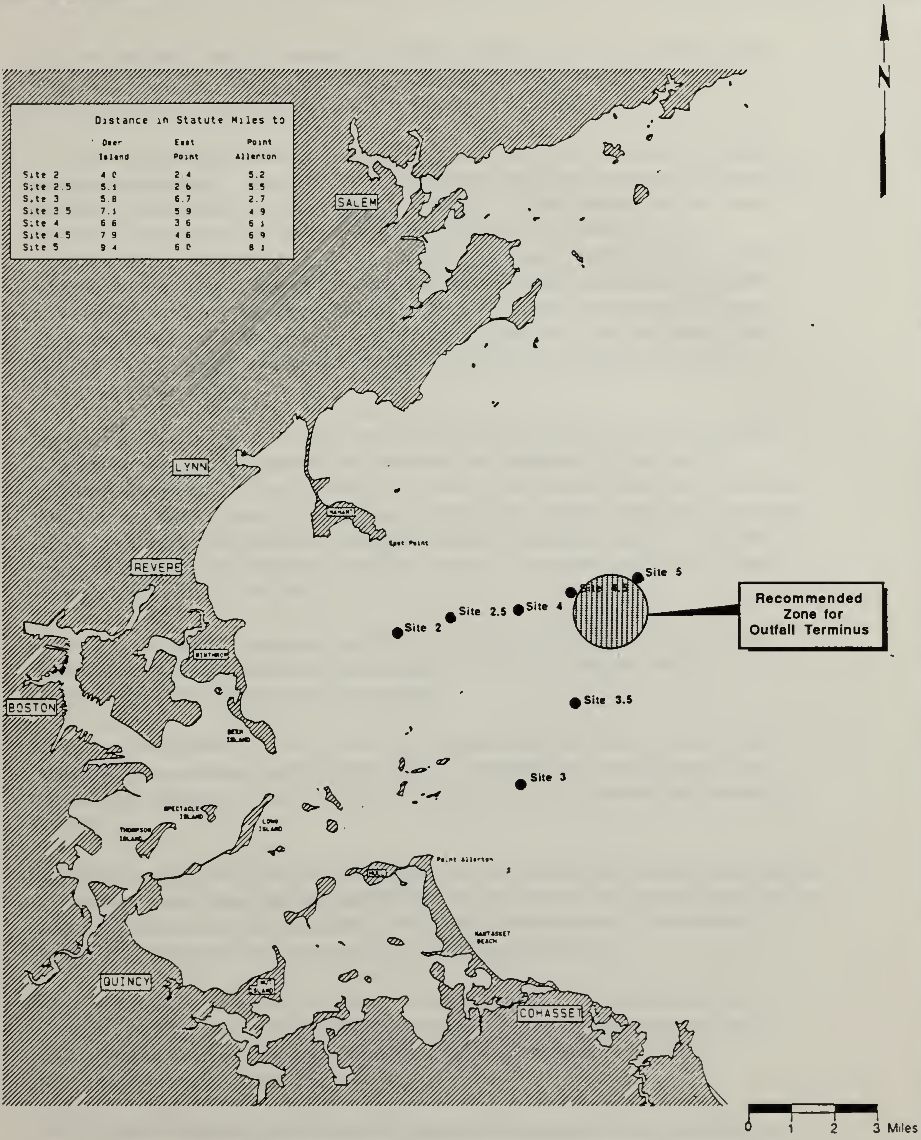
5.2 DESCRIPTION OF ALTERNATIVES

As was the case with the inter-island conveyance system, there is little evidence to suggest that dredged pipeline construction is either economically or environmentally feasible. Preliminary analysis also suggests that a mixed technology, tunneling and dredged pipe, would be considerably more costly and environmentally disruptive than tunneling alone. Accordingly, all alternatives discussed in this document are based on the construction of a tunnel to the discharge point. The tunnel will be constructed from a single vertical shaft located on Deer Island. The length of tunnel required to reach the most distant site is at or near the feasible limit of construction from a single heading. Also, tunnels to the farthest sites are at the limit of gravity flow, given currently-planned plant hydraulics. Thus more distant sites (beyond site 5.0) are likely to require two headings (including an intermediate shaft) and an effluent pumping station. Figure 5-1 shows the location of the candidate site, the distance of each site from the shoreline, and the depth of water at each of the locations.

The candidate sites can best be understood by first describing the circulation, sediment depositional patterns and resource distribution within the area. Understanding these patterns provides a better basis for understanding the evaluation of environmental criteria.

The difference in circulation among candidate sites varies markedly. Two zones of circulation exist; a nearshore zone comprising Sites 2.0, 2.5, and 4.0 on the north and Site 3.0 on the south, and on off-shore zone, comprising Sites 4.5 and 5.0 on the north, and Site 3.5 on the south. Circulation patterns in the nearshore zone are most strongly influenced by tidal action, while those in the offshore zone are influenced not only by tidal action, but by the large-scale circulation of Massachusetts Bay itself.

This difference among zones has a large impact on outfall site selection. First, the direction of net circulation varies. At the nearshore sites, net circulation has a dominant east-west,



	Distance in Statute Miles to		
	Deer Island	East Point	Point Allerton
Site 2	4 0	2 4	5.2
Site 2.5	5.1	2 6	5 5
Site 3	5.8	6.7	2.7
Site 3 5	7.1	5 9	4 9
Site 4	6 6	3 6	6 1
Site 4 5	7 9	4 6	6 9
Site 5	9 4	6 0	8 1

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FIGURE 5-1
RECOMMENDED OUTFALL LOCATION

[illegible]

or on- and off-shore trend. In contrast, the offshore locations have a strong north-south trend, along the coast. Second, the average dispersive capacity of the outermost sites is three to four times greater than the dispersive capacity of the innermost sites.

The sediment depositional patterns of the study area also vary. Two broad types of bottom characteristics are found: erosional, where the bottom is devoid of accumulated sediment, and depositional, where there are accumulations of sediment. A third category has also been identified: a transitional area where material is deposited for short periods but is transported either during storms or during other physical events. However, for purposes of this study, ultimate depositional or erosional areas are of greatest importance for long-term placement of an effluent discharge. The distinction is important because many pollutants concentrate themselves in the sediment and this can be magnified in the food chain. The difference in depositional patterns also provides an indicator of the relative vigor of the mixing of adjacent waters.

The areas adjacent to Sites 3.5 and 5.0 are best described as erosional, where the bottom is composed mostly of rock or cobbles with little overlying sediment. All other sites are considered depositional, in that there are broad areas of accumulated sediments. Within these areas there are apparent trends in the sediment geochemistry, which suggest that areas around Site 2.5 are concentrating pollutants to a higher degree than adjacent regions. This would suggest that this area may serve as a long-term reservoir of sediments, and that pollutants would be concentrated in this zone.

Modeling of the sediment deposition patterns also shows the same effect. Differences in sediment rates lead to the conclusion that nearshore sites accumulate sediments at approximately five times the rate of offshore sites.

Several marine resources now exist in the study region and adjacent areas. These include recreational uses of marine waters such as boating and fishing, commercial uses such as lobstering and fishing, and other resources which support these recreational and commercial activities.

Recreational uses of the regions around the study area are concentrated in closer proximity to the nearshore sites. Major regional beaches exist in Hull, Revere, and on the Nahant Bay side of the Nahant peninsula. Smaller, local beaches dot the entire coastline. Recreational boating and fishing are also concentrated closer to the nearshore sites.

Active commercial fisheries are distributed throughout the region. Lobstering is more extensively practiced at sites inward of Sites 4.0 and 3.5, while trawling occurs at most locations except Site 3.5. Fisheries statistics suggest that nearshore sites are more productive and diverse than are offshore sites.

The distribution of marine resources closely follows the commercial use of the region. In addition, areas within three miles of the shoreline are closed to commercial fishing during certain times of the year because of the presence of winter flounder spawning grounds and an attempt to distribute fishing activities more uniformly.

5.3 EVALUATION OF ALTERNATIVES

As with other major components of the project, four broad categories of criteria have been established for evaluating the alternatives. These include environmental, technical, cost and institutional criteria.

5.3.1 ENVIRONMENTAL CRITERIA

In developing an overall evaluation of the environmental suitability of different sites as locations of the outfall, Sites 4.5 and 5.0 have been identified as preferred sites. The rationale for this conclusion follows:

- The offshore sites offer the greatest potential for meeting numerical water quality criteria and standards. It is important to note that at all locations, source control of certain compounds to meet water quality criteria will be required. However, the outer sites, because they provide more robust mixing, provide the greatest opportunity to meet or exceed these criteria.

- The offshore sites minimize problems associated with sediment accumulation and concentrating of pollutants. While there are no criteria currently available to define the importance of any specific level of contaminants in the sediments, the differences in deposition and chemistry demonstrate that offshore sites are better (e.g., less contaminated).

- The offshore sites present the least opportunity for adverse impact on shoreline resources and aesthetics. The potential for creating nuisance algal blooms, which can be both an aesthetic and an environmental concern, is significantly less at the offshore sites because of to their distance from other sources of contaminants and because of the more robust mixing that occurs. Moreover, the discharge will be trapped low in the water column and more frequently at the farther sites. This serves to minimize algal blooms and prevent excursions of the effluent onto the shoreline.

- Sites further from shore are least likely to impact commercial uses of the marine resources. While resources exist throughout the region, their greatest abundance is located nearer the shore. Most notably, lobstering is conducted more extensively at Sites 2.0, 2.5, 3.0, and 3.5, and less so at 4.0, 4.5, and 5.0. Finfishing is less productive at Sites 3.5, 4.5, and 5.0. Areas within three miles of the coast are closed to fishing during certain times of the year because of their importance as spawning grounds, indicating again the sensitivity of these nearshore sites.

- Because off-shore sites would result in fewer impacts as measured by long-term mixing, sedimentation and avoidance of important resource areas, they are judged to provide the greatest protection of local species from adverse stress.

- Finally, the outer sites offer the least potential for impacts on historical shipwrecks.

In most other respects, the sites are equal. It is generally possible to meet the coliform criteria at all locations, and all alternatives have similar impacts with regard to noise and traffic.

5.3.2 TECHNICAL CRITERIA

All alternatives are essentially the same when compared by most technical criteria. All sites are judged to be equal in terms of reliability, operational complexity, and power needs because they are all gravity flow designs. This would translate to high reliability, low operational complexity, and minimal power needs.

In all cases, the construction of the alternatives is considered to be aggravated because of the nature of the expected method of construction. Sites further from shore are slightly more complex because of the difficulty of constructing such a long bore from a single heading, and because of the greater volume of tunnel spoils associated with the longer tunnel. Work underway suggests, however, that the greater volume of spoils may not be as negative a factor as previously thought - as it may be possible to use the spoils either as aggregate for low strength concrete, or as part of the Third Harbor Tunnel backfill requirements.

For the final technical criterion, flexibility, the offshore sites are assessed to be better. This criterion measures the capacity of any alternative to accommodate future changes - such as modified water quality requirements. As was noted in the environmental review section, the more offshore sites have a greater capacity to accommodate such changes.

5.3.3 COST CRITERIA

The cost criteria represent the financial investments which must be made for each of the alternatives. For most of the projects in the Deer Island STFP, cost criteria include considerations of both capital and operating costs. The outfall alternatives under investigation have essentially no operating costs because all designs are for a gravity-flow system. Accordingly, the most appropriate comparison is on the basis of project costs. The following table shows the differences in estimated construction costs:

Estimated Construction Costs ($ Millions)

Site	Cost*
2.0	$275
2.5	311
3.0	332
3.5	375
4.0	376
4.5	387
5.0	467

*Based on an Engineering News Record Construction Cost Index of 4440 for September, 1987.

It should be noted that the above costs include between $120 and $150 million for construction of the diffuser, with the remainder of the costs associated with the tunnel itself. Thus, alternatives which would involve constructing an outfall to one location, with the idea that it may be moved later, could incur a financial penalty of at least $120 million related to this later relocation.

5.3.4 INSTITUTIONAL CRITERIA

The institutional criteria measure the differences between sites by ease of implementation (coordination requirements, permitting), and scheduling impacts, as well as the demand for unique construction resources. All sites are considered the same when measured by these tests.

The differences in estimated construction time are small - ranging from 47 months at the inner sites to 56 months at the furthest site. Moreover, the permitting requirements and construction resources are the same regardless of the site. And finally, the outfall project cannot be built in sequentially-phased operating elements. Accordingly, all alternatives were not considered to be amenable to phasing.

5.4 RECOMMENDED PLAN

The proposed effluent outfall should be located in the region bounded by Sites 4.5 and 5.0 as shown in Figure 5-1. A comparison of Sites 4.5 and 5.0 indicates that Site 5.0 offers some additional environmental benefit, but cost considerations favor Site 4.5. The early design phase of the outfall should be focused on collecting detailed topographical and geotechnical information on the bottom in this region to facilitate the selection of the construction site. Additional monitoring, recommended below, will also be used to determine if there are any environmental factors which might indicate a clearer preference for the location of the diffuser within the region recommended.

These two sites represent the optimum mix of characteristics of good outfall sites: they are within the large-circulation patterns of Massachusetts Bay, and therefore provide the most robust long-term mixing. They are in regions of lesser potential sediment accumulation, thereby avoiding problems associated with concentrating pollutants in bottom sediments. They are located at a greater distance from extensively utilized nearshore resources, thereby avoiding the potential for disruption. Both sites can be reached by gravity and will support construction in a timeframe consistant with the court-ordered target dates.

The other shoreward sites do not represent viable options for the long-term discharge of effluent from the Deer Island facility. Outfalls placed in these locations are marginally acceptable when measured by current numerical criteria. But they are not acceptable when measured against non-numeric criteria. Of particular concern is the greater sediment accumulation that would occur at these sites, the potential for accelerated eutrophication because of nutrient build-up, and the proximity of these sites to important, intensively utilized resources.

In conclusion, the risk associated with attempting to place an outfall at the shoreward sites is not in the best long-term interest of MWRA. To attempt to fit the outfalls into these sites would place a greater burden and reliance on MWRA activities in the area of toxics and nutrient control and would provide little margin of safety for future changes in water quality requirements. If it should ever come to pass that a more extended outfall (in the case of the nearshore sites) were deemed necessary, the Authority would then incur a significant financial penalty.

The outfall structure should be built as a deep rock tunnel. In all cases, the diffuser, which provides initial mixing of the discharge, should consist of the final 1.25 miles of tunnel, from which 80 riser pipes extend from the tunnel to the sea floor. The underground portion of the diffuser will simply be an extension of the tunnel itself. The riser pipes will be constructed by drilling approximately four-foot-diameter shafts down to the tunnel. Special caps will be provided at the seabed to discharge the effluent into the marine environment. The diffuser section is shown in Figure 5-2.

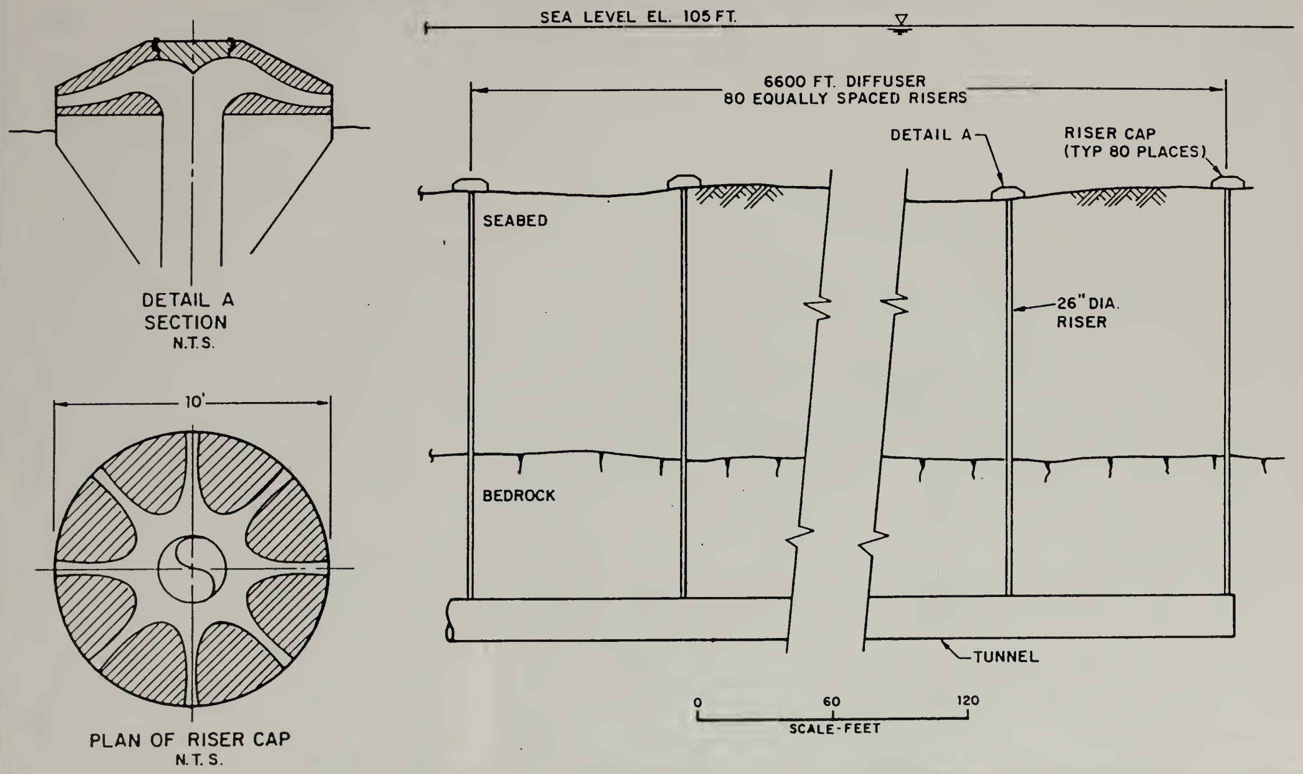

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FIGURE 5-2
DIFFUSER SECTION

Section 6

6.0 EARLY SITE PREPARATION

6.1 INTRODUCTION

The limited size of Deer Island, maintenance of the existing treatment plant operation, overall court-imposed schedule milestones, environmental and institutional factors, large volumes of materials that must be moved, large size of the new primary and secondary treatment facilities, and the hydraulics of the treatment system combine to produce a complex total site development plant.

Early site preparation, the initial phase of this overall plan, consists of those construction activities which can be initiated at an early date to prepare Deer Island for the late 1990 start of construction of the new treatment facilities.

The major activities of early site preparation include protection of the existing plant outfall pipes followed by the on-site relocation of existing grit and screenings to a secured landfill, the excavation of a sizeable segment of the central drumlin, and the creation of visual and noise barrier landforms. Demolition of the existing water reservoir atop the central drumlin and demolition of the Fort Dawes structures will also be accomplished.

Environmental impacts will be mitigated by various noise, visual, odor, traffic, and land-use restrictions. Costs and schedule will be optimized by adherence to the recommended plan.

6.2 RECOMMENDED PLAN

The recommended plan for early site preparation is described below:

The first early site preparation activity required to be accomplished is the installation of necessary additional protection for the several existing outfall pipes buried along the west side of Deer Island between the plant and the harbor. Without support or load transfer modifications, repeated heavy construction loads and/or additional loads due to proposed landform construction over the pipes near the southern end of the island will subject the pipes to stresses that may exceed the allowable limits. Identification of the sources and magnitudes of the additional loads early on in the design phase of the project is critical to allowing the design of any required modifications to proceed.

Removal, transport and disposal of the existing 85,000 yd^3 of grit and screenings is another activity that requires a very early start. The process involves the development of a new landfill south of the existing grit and screenings waste areas followed by excavation and disposal of the waste. In order to mitigate odors associated with the transfer process, the activity will be limited to the cooler months of the year.

Since only two colder weather construction periods will be available (1988-89 and 1989-90) to complete the transfer of this waste prior to the start of the new primary plant construction, early planning, design and contract award are essential. Two on-site alternatives were

evaluated for grit and screening disposal: (1) transfer of untreated waste to a secure landfill; or (2) chemical stabilization of the waste by the Chemfix process. While both alternatives are feasible, the disposal by the secure landfill concept is the recommended alternative since it can be accomplished in a shorter time, at a lower cost, and with less environmental impact than the chemical stabilization process.

Removal of a portion of the central drumlin is also an essential part of the recommended early site preparation plan. Not only is the excavation of over 1.6 million yd^3 required to establish the 125 ft grade elevation for construction of the primary treatment plant, but drumlin soils are to be used in landform creation and as stabilizing and cover material for the grit and screenings area.

Since the on-island piers will not be operational until late 1989, the inability to remove and dispose of excavated drumlin soils from the area which will be needed for new primary plant construction is a constraint that is best circumvented by the use of existing prison property. The existing use of Deer Island is shown in Figure 6-1.

The recommended plan, shown in Figure 6-2, is based on obtaining complete access to the Deer Island House of Correction property by 1989. Access to prison property allows the creation of permanent noise and visual barrier landforms which are preferable to the phased construction of barriers that will have to occur if prison property access is unavailable. Complete prison property access also eliminates the need to implement special costly mitigation measures that may be required to minimize the impacts of construction on the inhabitants of the prison.

The decommissioning and removal of the cooling water reservoir built into the top of the drumlin must be accomplished before the early site preparation phase of drumlin excavation can be completed. The recommended plan includes the provision of an alternate cooling system back-up to the primary service water system.

Other activities to be completed during the early site preparation period are demolition of Fort Dawes, relocation of the existing island acccess facilities (including the roadway, parking lot, the security station and fencing) and the clearing and grading of the five-acre area for the concrete batch plant.

The estimated project cost of the recommended plan for early site preparation work is $17.4 million.

6.2.1 ENVIRONMENTAL CONSIDERATIONS

The environmental impacts of Early Site Preparation will be minimized as a result of several major mitigation steps associated specifically with the recommended plan.

Air Emission Control

The excavation of the grit and screenings disposal areas have the potential to create odors. These potential odors are likely to be detectable only within the immediate vicinity of

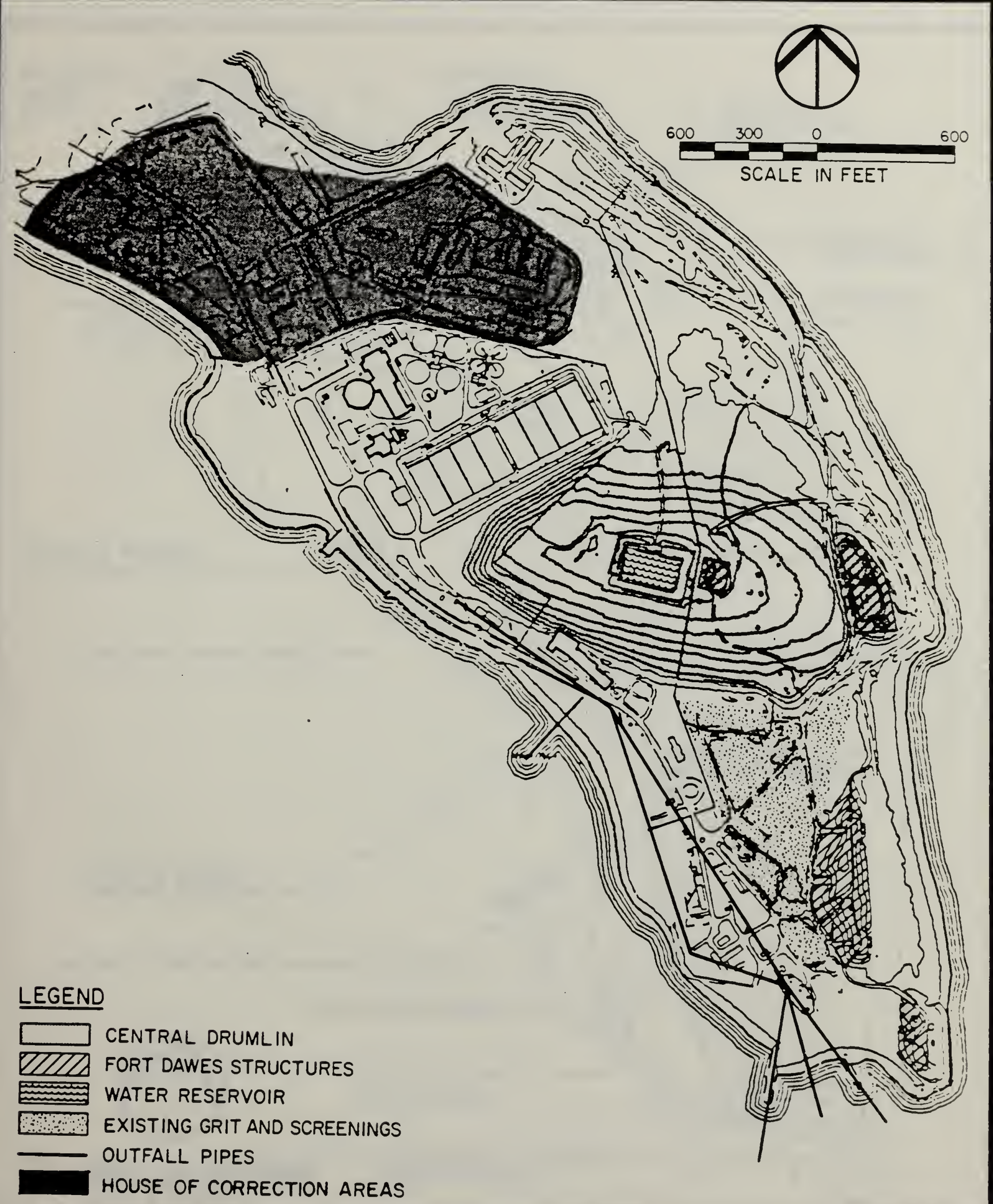

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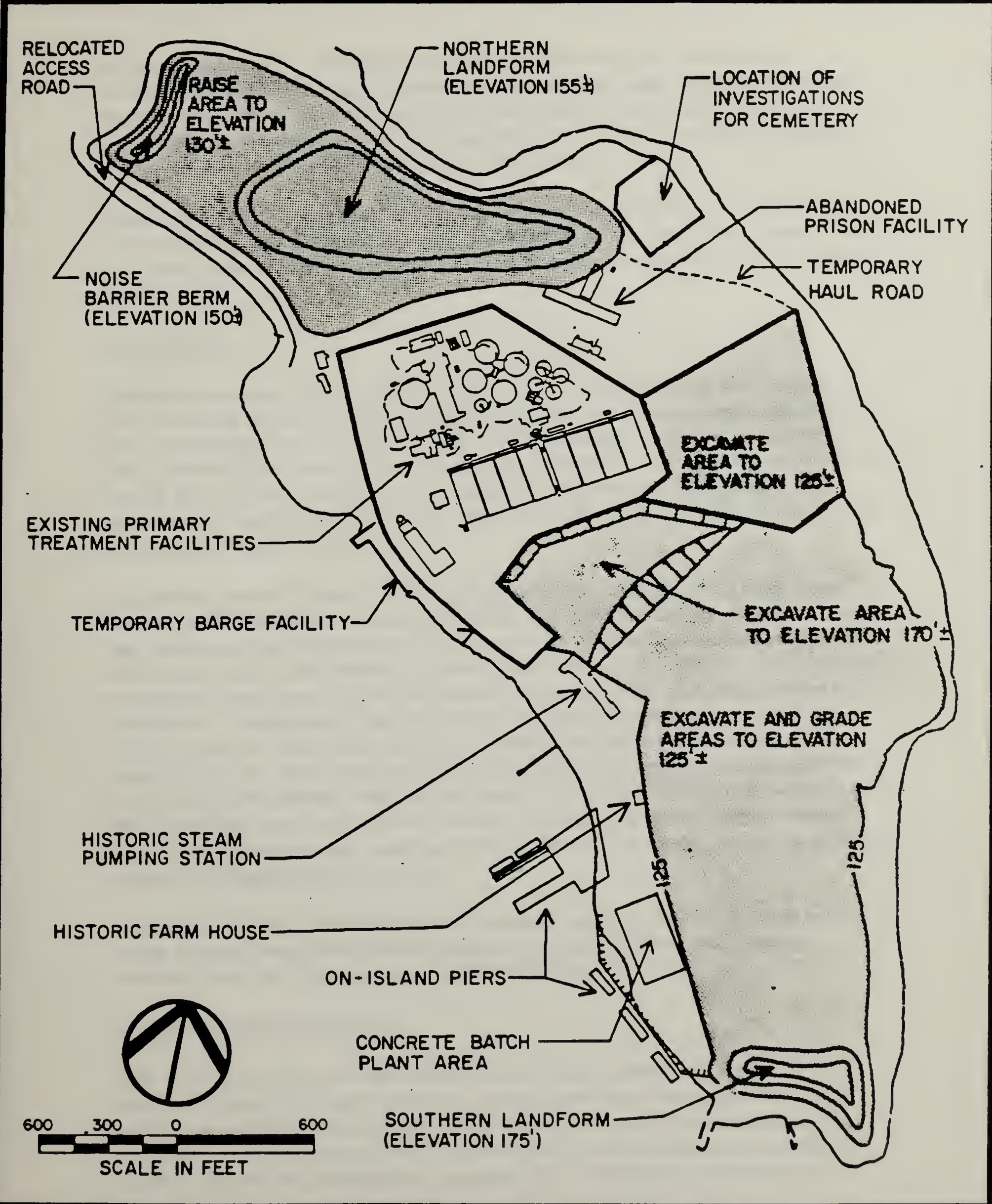
FIGURE 6-1
EXISTING DEER ISLAND LAYOUT



MASSACHUSETTS WATER RESOURCES AUTHORITY	FIGURE 6-2 EARLY SITE PREPARATION FOR DEER ISLAND - RECOMMENDED PLAN (DECOMMISSIONED PRISON)

the construction areas. To minimize the potential for such odors, the excavation and landfilling of these materials will be performed only during the cooler months, to the extent feasible. Furthermore, the landfill surface area and frequency of exposure of the grit and screenings to the air will be minimized by compacting the grit and screenings to one-foot-thick layers, each separated by a six-inch layer of soil for cover.

Fugitive dust from soil excavation and filling activities will be controlled as required by the use of sprinkling trucks. Potable water can be pumped to storage tanks during off-peak hours if sprinkling water requirements are found to place an unusually high demand on the existing supply.

Noise Control

Construction activities generating off-island noise will be minimized by the early building of landforms across the narrow width of the north end of the island, using drumlin-excavated soils. This mitigation activity, however, is itself a noise generator. To minimize the noise levels generated by the construction of the northern landforms, construction in these northern areas of the island will be restricted to one-shift, daytime operations. The complete construction of the landforms will require approximately 350 work days beginning in late 1988 and extending through 1990.

The dominant sources of noise from this activity will be the trucks delivering the drumlin material, the bulldozers and scrapers used to shape the landforms, and the compactors to be used on the north end of Deer Island. The expected initial sound level for construction of the noise barrier berm is approximately 61 dBA at Tafts Avenue on Point Shirley. For construction of the noise barrier berms, special quiet-wheeled bulldozers will be used, supplemented by a mobile crane. Construction of this noise barrier will take approximately one month. By keeping as many activities behind the berm as possible, the anticipated noise level will be reduced to 51 dBA. If the noise barrier berm were not created and standard equipment and normal construction methods were used, the sound level throughout this activity would be 66 dBA. Landfilling construction activities required to complete the raised, northern platform area will generate an estimated noise level of 51-57 dBA at Point Shirley, depending upon the degree of shielding provided by the berm.

Once completed, the noise barrier berm and northern landforms will serve as noise barriers against the sound levels which could be expected at the nearest off-site residence from subsequent early site preparation and construction activities.

Historical and Archaeological Sites

None of the construction activities planned for early site preparation will displace or directly affect any of the historic structures on Deer Island. Early site preparation activities, as shown in Figure 6-2, will be in proximity to the steam pumping station, the farmhouse, the historic cemetery, the Hill Prison and the Prison Superintendent's Office. Measures required for protecting these resources will be identified in a Memorandum of

Agreement between the Massachusetts Historical Commission, the MWRA and EPA. It is expected that, during early site preparation, the buildings will be protected against destruction or further deterioration. Earth moving equipment will not be used closer than the concrete wall at the back of the farmhouse. Shoring of the steam pumping station where it backs onto the central drumlin may be necessary. Openings in the buildings will be closed with plywood. The cemetery will be protected by fencing.

Traffic

Daily traffic impacts from early site preparation activities will be controlled as a result of mitigation measures including on-site placement of excavated soils, selective barging of materials to the site, and off-peak hour scheduling of work shifts for construction workers. Almost all of the 40-50 pieces of equipment required will be delivered only once to Deer Island where they will remain for the duration of this phase of the project. The vehicular traffic created by construction personnel involved in early site preparation will average 70 round trips per day. Additional daily truck traffic to support on-site activities and to provide early site preparation materials will average only 2-3 round trips per day. The 17,000 yd^3 of sand associated with the leachate collection system for the new landfill will be barged to Deer Island directly. Approximately 20 barge loads over a 2-3 month period will be required to complete delivery of this material. Barge mooring dolphins and a crushed stone pad will be provided at the barge unloading area to permit delivery of this sand.

Terrestrial and Aquatic Ecosystems

Impacts on the local terrestrial and aquatic ecosystems will be minimal. A majority of the present day site is either used for urban activities or is covered with a scrub growth of coarse grasses and brush. None of the faunal species displaced as a result of vegetation removal, particularly from the central drumlin, are endangered, threatened, or otherwise unique. There are no native biological communities in the service water reservoir.

Because of the extensive surfaces which will be cleared, grubbed, and graded during early site preparation, a mitigation program will be necessary during construction to control erosion and prevent sedimentation into adjacent areas.

Double lining of the secure landfill for grit and screenings will prevent leachate contamination of the island and harbor waters.

Modifications which will be made to an existing rock bulkhead wharf, to allow for off-loading of sand from barges, will have a minimal impact on marine resources due to the limited nature of these construction activities.

Power Needs

The activities associated directly with early site preparation will not place any significant demands on the site power supply. An increase in the electrical power demand during the early

site preparation period will result from other construction activities, such as the construction of pier facilities, interim sludge dewatering, construction of temporary shelters, lighting and miscellaneous demands.

Quantity and Quality of Spoils

Approximately 1.6 million yd^3 of drumlin excavated material and 85,000 yd^3 of grit and screenings will be moved during the early site preparation period.

This material will remain on-island to construct the berms/landforms needed to reduce visual and noise impacts. Approximately 50,000 yd^3 from the Fort Dawes and reservoir demolition will also remain on-island as backfill and berm material.

Costs

Federal and state grant applications for up to 90% of the $17.4 million early site preparation costs will be filed to minimize the financial impacts of this project. Annual operating costs of the constructed facilities are expected to be minimal.

Section 7

7.0 INSTITUTIONAL CONSIDERATIONS

7.1 PROJECT SCHEDULE

Institutional Considerations identifies the permitting, program management, financing, human resources and regulatory requirements for constructing and operating the recommended facilities within the schedule entered by the Federal Court. The analysis includes a review of the court-ordered target dates and recommends any changes in the schedule that are deemed necessary.

The target dates entered by the Federal Court for the construction of the treatment facilities, outfall and inter-island wastewater conveyance system are as follows:

o	Initiate construction of new primary treatment facilities	12/90
o	Complete construction and commence operation of new primary treatment facilities	7/95
o	Initiate construction of outfall	7/91
o	Complete construction of outfall	7/94
o	Initiate construction of inter-island wastewater conveyance system	4/91
o	Complete construction of inter-island wastewater conveyance system	4/94
o	Initiate construction of secondary treatment facilities	during 1995
o	Complete construction of secondary treatment facilities	during 1999

The target dates formed the initial basis for developing the preliminary Summary Project Construction Schedule shown in Figure 7-1. This preliminary schedule shows a logical way of constructing the secondary treatment facilities in accordance with acceptable construction methods and practices. The schedule recognizes the project's complexity in terms of limited site availability, the large quantities of excavated materials, and the need for water transport of vast amounts of equipment, personnel and materials. The schedule includes limited provisions for such foreseeable risks as weather, but it does not address such events as worker disputes, strikes and Acts of God. These acts, and their impacts on the schedule, will be identified, recorded and monitored by the Program/Construction Management team retained by the Authority to manage the day-to-day project activities.

The schedule also illustrates the division of the major construction activities into manageable construction packages. The schedule reflects the anticipated permitting, agency review,

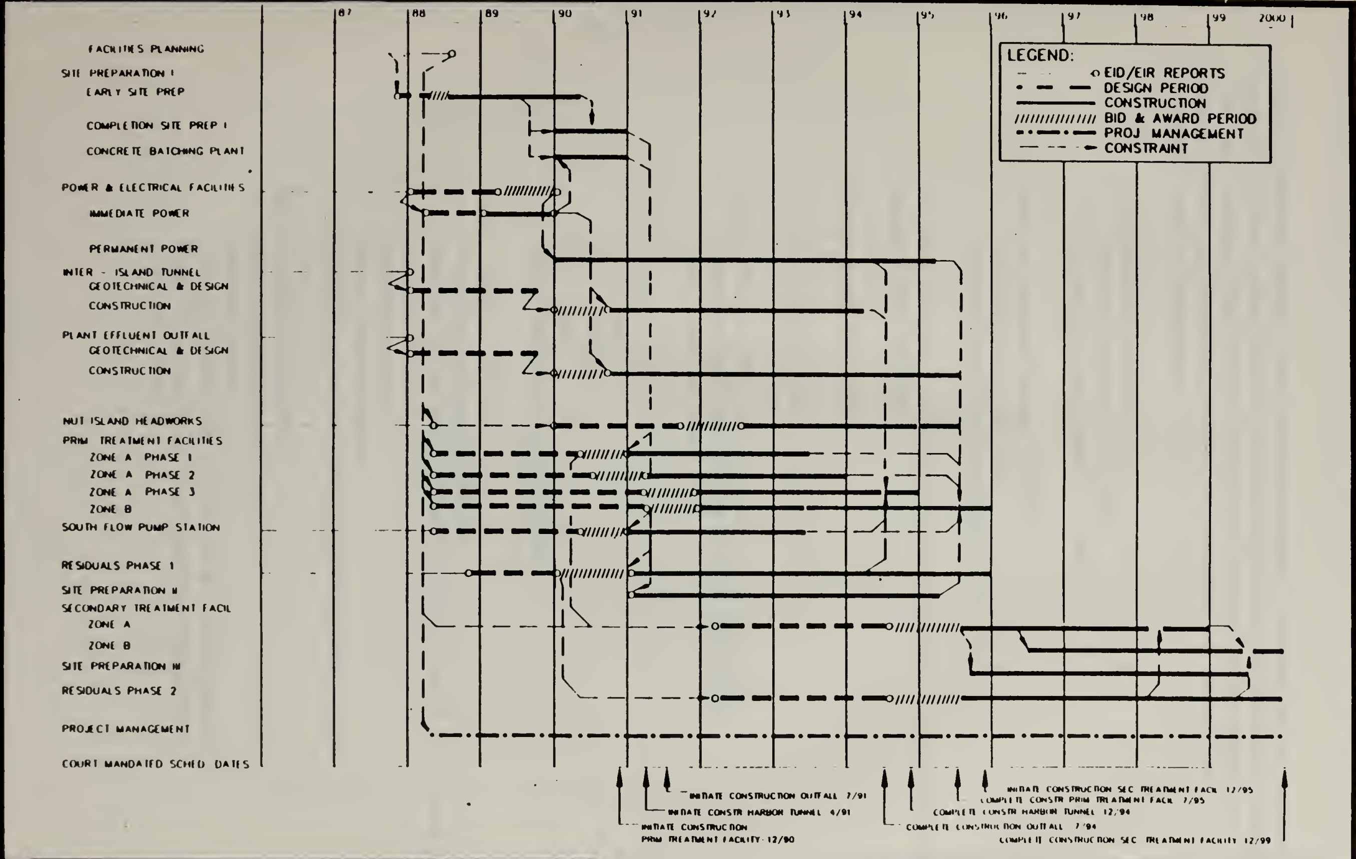


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FIGURE 7-1
SUMMARY OF PROJECT CONSTRUCTION SCHEDULE

design, bid and award periods for each construction package. The design, bid and award periods for each construction package are phased to allow for the necessary coordination and monitoring of the many contractors to be working on Deer Island at the same time, and to facilitate the ferrying of workers and construction materials from the off-island pier facilities. The preliminary construction packages are:

- Site Preparation I, 1988-1991
  - Early Site Preparation, 1988-1990
  - Completion of Site Preparation I, 1990-91

- Power and Electrical Facilities, 1988-1995
  - Immediate Power, 1988-1990
  - Long Term/Permanent Power, 1988-1995

- Nut Island Headworks, Inter-Island Wastewater Conveyance Tunnel, and South System Pumping Station, 1990-1994

- Effluent Outfall, 1990-1995

- Primary Treatment Facilities

  Zone A, Phase 1 -- 1991-1993
  - Main Pump Station and Winthrop Terminal Modifications
  - North System Force Main

  Zone A, Phase 2 -- 1991-1993
  - Grit Facilities
  - Control Building
  - Odor Facility
  - Administration and Laboratory Building

  Zone A, Phase 3 -- 1992-1994
  - Primary clarifier batteries A and B
  - Temporary primary conduit connecting Selectors A and B to the existing outfall
  - Primary splitter box
  - Secondary splitter box
  - Primary screening facilities
  - Primary sludge and scum pumping galleries, batteries A and B

  Zone B, Phase 4 -- 1992-1995
  - Primary clarifier batteries C and D
  - Selectors C and D
  - Temporary conduit from Selector Zone B to existing outfall
  - Primary sludge and scum pumping galleries, batteries C and D
  - Maintenance Building

- o Residuals Phase I, 1991-1995
- o Site Preparation II, 1992-1995
- o Secondary Treatment Facilities, Zone A and Zone B, 1995-1999
  - Secondary Treatment Facilities, Zone A, 1995-1998
  - Secondary Treatment Facilities, Zone B, 1996-1999
- o Residuals Phase II, 1995-1999

The preliminary construction schedule is predicated on the construction of complete operational treatment zones (i.e. Zones A and B) rather than on the construction of the entire treatment plant in a single project. This type of planning allows for the early completion, operational testing, and acceptance by the Authority of individual parts of the plant.

Prior to the initiation of construction of Zone A of the new primary treatment facilities, extensive site preparation activities must begin on Deer Island as early as 1988 in order to prepare a level platform for the siting of the primary clarifiers. As part of this 1988-1990 early site preparation effort, the existing outfall pipes will first be protected against heavy construction equipment and/or loads. The existing grit and screenings landfill will be excavated, stabilized as required, and hauled to a previously prepared, doubly lined, on-island disposal area at the southern end of Deer Island. A major portion of the central drumlin will be excavated to begin preparation of the level platform for construction of the primary facilities and preparation of a site for the concrete batching plant; the excess materials will be used on-island to develop visual and noise barrier landforms at the northern end of the island. Existing structures such as Ft. Dawes and the water reservoir atop the drumlin will be demolished and a new non-potable back-up service water system will be installed. The prison area will be used to begin the construction of the northern landforms. Should the prison still be in operation during 1988-90, the existing prison recreation area will be relocated to allow for the use of the existing area for the disposal of excess materials; the south area reserved for residuals facilities will be used to temporarily store the remaining excess material.

After completion of the on-island pier facilities, the remainder of the central drumlin will be excavated. By the end of 1990, the concrete batching plant will be completed, the prison facilities demolished if the prison has been decommissioned, and construction will begin on the shafts for the inter-island wastewater conveyance tunnel and the outfall tunnel.

In addition, prior to the start of the construction of the primary facilities in December 1990, installation of an immediate power supply will be required to meet the power needs of operating the existing treatment facility and constructing the two submarine tunnels. An immediate power supply will be installed from Massachusetts Electric Company's Winthrop grid by January 1990 to provide 15 MW of power to support tunnel construction activities.

Construction of the first phase of the permanent power facilities will begin by January 1, 1990. Completion of the first underharbor 115 kv permanent feeder from Boston Edison company's K Street station will be accomplished by the end of 1991 to meet the power needs of the primary

sludge dewatering facilities, the on-island piers, and basic plant power requirements. The second 115 kv permanent feeder from BECo's Chelsea station and the recommended combined cycle on-island power plant will be completed by January 1995 to meet the needs of the new primary facilities and to satisfy the requirement for an uninterruptible supply should the tie with the utility fail.

The extensive geotechnical exploration program required to support the 1990 design of the inter-island conveyance system and outfall tunnel will begin in 1988. Based on the estimated advance rates for the tunnel boring machines, construction of the outfall tunnel must begin late in 1990. This start date will allow the outfall to be operational in July 1995 at the same time that the new primary facilities are placed in service.

Construction of the inter-island conveyance system could begin anytime from late 1990 to April, 1991. This tunnel will be completed in approximately three years.

The construction of the Main Pump Station and Winthrop Terminal modifications and the North System Force Main components of the primary treatment system will begin during December 1990. Construction of the new South System pump station required to lift South System flows up from the inter-island wastewater conveyance tunnel will also begin in 1990 as will the first phase of the new residuals facilities. The second phase of the site preparation efforts will begin in 1990 to prepare the central island area for the construction of the secondary facilities, construct berms in the north and east areas, and handle the outfall and inter-island tunnel spoils. Bidding and award of the construction contracts will allow the remainder of the primary treatment facilities to begin construction from early 1991 to 1992.

Construction of the Zone A primary clarifiers (A and B) and associated works will also be staggered. Phase 1 will be completed by mid-1993. Phase 2 of the Zone A primary clarifiers will be completed by the end of 1994, and Phase 3 by the end of 1994. The phased construction of the primary treatment zones will permit the early operation of the completed primary clarifiers in 1994, resulting in improved treatment and the testing of equipment during the warranty period and under actual operating conditions.

Construction of Zone B (C and D) primary clarifiers and associated works will be completed by July 1995. Operational testing of the new primary treatment facilities will continue through the remainder of 1995. The Nut Island headworks will be operational in mid-1995 when the new primary facilities are available to treat the South System flows. Phase 1 of the residuals facilities will also be available at that time.

Phase II site preparation efforts to prepare the central island area for construction of the secondary treatment facilities will be completed by the end of 1995. This will complete the major earth movement activities on the island, as well as tunnel excavation efforts. The excess materials will either be used to develop on-island noise and visual barriers, or transported off-island for disposal. Construction of the Zone A secondary clarifiers will begin in this central area by the end of 1995 in accordance with the court schedule.

The Zone B secondary clarifiers will begin construction in mid-1996. With the completion of the Zone B secondary clarifiers and Phase II residual facilities by the end of 1999, the new Deer Island Secondary Treatment Plant will be operational. This schedule is only achievable, however, if the following critical path activities are completed on time:

- Implementation of the geotechnical information gathering effort in the spring of 1988 to support the design of the tunnels.

- Initiation of the design of the new primary treatment plant facilities immediately following approval of the Facilities Plan in May, 1988.

- Demolition and removal of the Hill Prison by 1989, or the use of the reserved residuals area for storage of excess excavated materials generated during the Early Site Preparation period.

- Removal and reburial of the existing grit and screenings by 1990.

- Provision of an interconnection with MECo's Winthrop grid by January 1, 1990 to meet the immediate power needs of the tunnel construction efforts.

- Completion of the first underharbor power cable by December, 1991, and the on-island combined cycle power plant by January, 1990, to meet both construction power needs and operating power needs of the new facilities.

- Completion of outfall construction by July, 1995, in time to receive flows from the new primary treatment facility.

- Successful completion of permitting requirements for each project component. Critical among the permitting issues are the need to immediately initiate permitting activities for early site preparation and utilities supply, and the need to develop a strategy for the re-use or disposal of approximately 1.0 to 1.7 million yd^3 of excavated material from Deer Island.

In addition, to ensure that the Deer Island project meets the scheduled completion dates within the project budget, the responsibilities of the Program/Construction Management Team retained by the Authority should include developing, overseeing, coordinating, monitoring, and administering all Deer Island secondary treatment facilities contracts related to the following programs:

- Equipment Pre-purchase -- the completion of construction on an optimum schedule may require extensive pre-purchase of critical equipment items.

- Overwater Transportation -- upon completion of the on-island pier facilites in 1989, at least 50 percent of the estimated peak workforce at Deer Island will be transported over water to the on-island job site via ferries from on-shore satellite parking

facilities. In addition, the vast majority of construction materials and equipment, as well as operations supplies, will be transported to Deer Island by roll-on/roll-off vehicles delivered by boats and/or barges traveling between the on-shore and on-island piers.

- Overland Transportation -- A maximum of 50 percent of the peak workforce will be bused to Deer Island from designated satellite parking areas.

- Concrete Production -- The total demand for concrete ranges from 0.8 to 0.95 million yd^3 depending on the length of the outfall. The peak demand years are 1992 and 1993, which will overlap with the peak demand years of the Central Artery/Third Harbor Tunnel Project.

7.2 PROGRAM MANAGEMENT

The overwhelming logistical requirements and strict court-ordered schedule associated with the facilities plan mandate that MWRA immediately expand its capability to manage large-scale, complex capital projects. The recommended steps for achieving this objective are:

- Create and staff an in-house Program Management Unit dedicated to monitoring the Agency's most complex capital projects. The role of this unit will be to provide executive control and direction, monitor the performance of consultants and act as a liaison between consultants and other MWRA divisions.

- Retain a Program/Construction Manager (P/CM) who will assume primary responsibility for day-to-day program management including the supervision of design, cost estimating, scheduling, permitting, value engineering, pre-purchase of equipment, engineering services during construction, facility testing and staff training. In addition, the P/CM will provide technical support for the Authority's decisions regarding contractor selection, change order control, progress payments and final acceptance.

- Retain a Lead Design Engineer who will assume responsibility for directing the design of the primary and secondary treatment facilities including the tunnels, power plant and on-site residuals management facilities. The Lead Engineer will develop design standards, provide drawings at the 10-15 percent completion level for all facilities, prepare a final design of the priority design packages, and oversee selected designers for the other design packages. The work of the Lead Engineer will be managed from an overall program perspective by the P/CM with particular emphasis on schedule, budget and constructibility issues.

- Request that the federal and state regulatory agencies immediately assign a full-time liaison to the MWRA's Program Management Unit to ensure effective coordination with the regulatory agencies in permitting and mitigation requirements.

7.3 PROJECT FINANCING

The construction of new facilities to clean up Boston Harbor and provide adequate sewerage service to the Metropolitan Boston area will entail a major financial commitment. In current-day dollars, it is estimated that new MWRA facilities related to these projects will cost approximately $3 billion. Since construction of these facilities will continue through the rest of the century, inflation will increase the actual cost. Once the facilities are constructed, the MWRA will have the additional responsibility and cost of operating the new facilities. The funds to construct and operate these facilities, if not derived from external sources (grants or loans) must be recovered through the Authority's charges to member communities.

The financial impact analysis focuses on three major components:

- Current Dollar Expenditures -- which describes the expenditures required annually, in current-day dollars, for construction and operation of new and existing facilities. The Capital costs are identified for the facilities included in the Deer Island Secondary Treatment Facilities Plan as shown in Table 7-1, other capital projects contained in the Authority's draft 1988 Capital Improvements Program, collection system projects identified as part of the EMMA study, and an allowance for miscellaneous divisional capital projects and allocated capital projects of the Authority's support divisions. No costs associated with future CSO projects are included in this analysis.

  Operating costs include the direct costs of the sewerage division, plus an allocation for other Authority operating expenses. Current MWRA operating costs are based on the FY 1988 operating budget. The existing operating costs for FY 1989 and FY 1990 are based on the MWRA's preliminary budget estimates for wages. Future year costs include the increased operating expenses associated with primary and secondary treatment, residuals management and the water transportation system.

- MWRA Revenue Requirements -- which projects the amounts in future dollars which must be raised by charges to the member communities to retire the debt associated with the construction program and to pay operating expenses. In estimating the amounts to be raised through charges, several different variables were considered. These include economic variables, such as anticipated rates of inflation, and financial variables, such as terms and rates for bond issues and the availability of grants-in-aid and/or loans from state and federal grants.

  In order to evaluate the range of effects which different assumptions about the variables might produce, a base case and four alternatives were constructed. The base case represents a prudent scenario: reasonable estimates of future economic and financial variables are made, and grants-in-aid are assumed to be available only to the extent to which these grants have already been committed to the Authority through FY 1988. The major assumptions of the base case are as follows: construction costs

TABLE 7-1

DEER ISLAND SECONDARY TREATMENT FACILITIES CAPITAL COST

	Cost in Millions
Nut Island Headworks and Site Restoration	$ 38
Inter-Island Conveyance System	84
South System Pumping Station	40
North Main Pumping Station, Winthrop Terminal and North Grit Removal	71
Primary Treatment Facilities	241
Secondary Treatment Facilities	551
Disinfection Facilities	22
Power Generation and Distribution	103
Site Work	109
Potable and Plant Water	19
Administration, Maintenance and Control Buildings	47
Effluent Outfall	466
CM/LE Services	95
TOTAL	$1,886

Note: The above costs reflect September 1987 costs and include 35 percent for engineering and contingencies. Costs do not include residuals handling facilities.

will inflate at 6 percent annually; operating costs will inflate at 5 percent annually; and bonds will be issued at a rate of 9 percent for a term of thirty years. Alternative 1 is similar to the base case, but assumes higher inflation and bond interest rates, plus a shorter term on the Authority's revenue bonds. Alternative 2 uses the base case assumptions, but also assumes the institution of a State Revolving Loan Program with a maximum annual loan amount of $50 million with interest at half the normal market rate. Alternative 3 is similar to Alternative 2, but assumes a more attractive State Revolving Loan Program with zero-interest loans and $100 million available per year. Alternative 4 is a "best likely case" scenario, assuming lower inflation rates and a low-interest State Revolving Loan Program in conjunction with a new grant program of 25%, with a maximum grant amount to the MWRA in any given year of $100 million.

o Community Allocation/Impacts -- which investigates the impacts of the MWRA charges on users served by two member sewerage divisions, the Boston Water and Sewer Commission and the Town of Needham. These two members were selected because they represent a fully self-sufficient local utility, and one which raises some of its wastewater expenses from tax levies. These approaches are representative of the local financing methods in use in the service territory.

The total cost of Deer Island-related projects in current dollars is $1.87 billion with annual expenditures reaching a peak of $260 million in FY 1992. The total current dollar value cash flow for all projects (Deer Island and non-Deer Island) is $2.9 billion.

Table 7-2 presents a summary of cash flow projections for construction-related costs for the base case scenario and the four alternatives. This table presents the net (less grants) constsruction costs, the estimated amount of annual Authority revenue bond issues, the Authority's total debt since payments, and annual debt service reserve deposits.

Table 7-3 summarizes the annual revenue requirements under the base case and the alternatives. This table presents the Authority's projected annual revenue requirements including total debt service, operating costs and reserve requirements by year.

The cost of financing the annual revenue requirements (net of grants and other sources of income) will fall on the users within the MWRA service area. The increased annual sewer charges will not impact all properties to the same degree. MWRA member communities pass the Authority's charges on to their own retail customers in a multitude of ways. These methods range from full recovery of the Authority charges through the communities' retail sewer rates to full or nearly-full recovery through ad valorem property taxes.

TABLE 7-2

COMPARISON OF NET CAPITAL CASH FLOW
(Base Case and Alternatives)
(Values in $1,000)

	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Base Case	75,361	95,636	180,550	322,220	440,155	471,009	440,852	381,532	396,321	450,560	471,980	351,364	128,955	41,743	35,948	38,105	40,392	42,815
Alternative 1	76,318	103,108	202,864	374,729	530,325	588,234	571,348	513,128	553,132	652,560	709,380	548,024	208,721	70,112	62,659	68,925	75,817	83,399
Alternative 2	75,361	95,636	180,550	322,220	440,155	471,009	440,852	381,532	396,321	450,560	471,980	351,364	128,955	41,743	35,948	38,105	40,392	42,815
Alternative 3	75,361	95,636	180,550	322,220	440,155	471,009	440,852	381,532	396,321	450,560	471,980	351,364	128,955	41,743	35,948	38,105	40,392	42,815
Alternative 4	72,591	85,107	155,562	269,664	351,252	361,360	333,575	287,679	307,758	352,973	364,271	259,933	82,933	25,465	26,806	28,773	30,212	31,723

TABLE 7-3

COMPARISON OF ANNUAL REVENUE REQUIREMENTS
(Base Case and Alternatives)
(Values in $1,000)

	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Base Case	148,631	207,372	253,374	307,089	358,750	384,861	426,143	479,957	533,549	596,543	655,789	663,094	677,194	688,106	703,848	720,419
Alternative 1	166,252	251,063	324,998	412,628	500,133	562,617	642,835	744,735	851,547	973,279	1,084,761	1,111,826	1,151,260	1,190,400	1,237,559	1,289,063
Alternative 2	147,264	204,640	249,275	301,623	351,918	376,662	416,579	469,026	521,252	582,880	640,760	646,923	660,041	669,911	684,550	699,951
Alternative 3	143,211	196,531	237,112	285,406	331,646	352,336	388,197	436,590	484,761	542,334	596,159	601,201	613,353	622,199	635,752	650,002
Alternative 4	133,302	173,424	197,759	226,757	254,442	259,035	278,842	308,514	336,812	374,358	413,173	413,999	420,552	423,447	430,631	438,072

As noted previously, the financial impact on users in two different communities were analyzed. While it is intended that the analysis be useful in determining the relative impact in all communities, it must be recognized that the number of different cost recovery mechanisms used and the diversity among MWRA member communities make a direct comparison between any two communities invalid.

The impacts presented for the two communities, Boston and Needham, are intended to show the total cost of providing wastewater service in each community through 2005. As such, the costs of each community's wastewater utility operations include the projected MWRA charges as well as projections of the communities' current local operating and capital (including debt) costs. The analysis of the future costs and needs in the communities is necessarily not as extensive as that performed for the Authority, and thus may understate the communities' future local costs.

Figure 7-2 presents the annual sewer bill (not including water) for a typical single-family residential customer in Boston under the base case and alternative assumptions. In the base case, the fee will increase from the current $100 per year to approximately $660 per year by the year 2005. In the "best case" the fee will increase from $100 to approximately $420; in the "worst case", the fee rises from $100 to about $1200. In evaluating this impact, it must be remembered that this sewer bill will be paid in inflated, year 2005 dollars.

Figure 7-3 presents the estimated future wastewater costs (sewer bill plus property tax) for a typical residential user in Needham. This analysis reflects Needham's policy of wastewater expense recovery whereby the amount of the last MDC assessment prior to the creation of the MWRA, plus all local wastewater-related expenses, are recovered through the Town's property taxes.

Under the base case assumptions, the fee for a typical residential user in Needham will increase from $137 to approximately $800. In the "best case," the fee will increase from approximately $137 to approximately $500; in the "worst case" the fee will use from $137 to over $1400.

All costs and financial impacts have been presented in terms of inflated dollars to account for expected increases in construction and operating costs in future years. Accordingly, all projected sewer assessments and retail bills would be paid in future dollars as well. To determine the impact in current-day dollars, an analysis was made assuming no inflation. Annual (sewer only) bills would increase to approximately $400 per year for a single-family user in FY 2005 in Boston and Needham under the base case assumptions with no inflation.

While construction and operation of new facilities to clean up Boston Harbor will be a significant cause in the projected increases in MWRA assessments and retail sewer bills, it must be acknowledged that these existing charges would increase due to

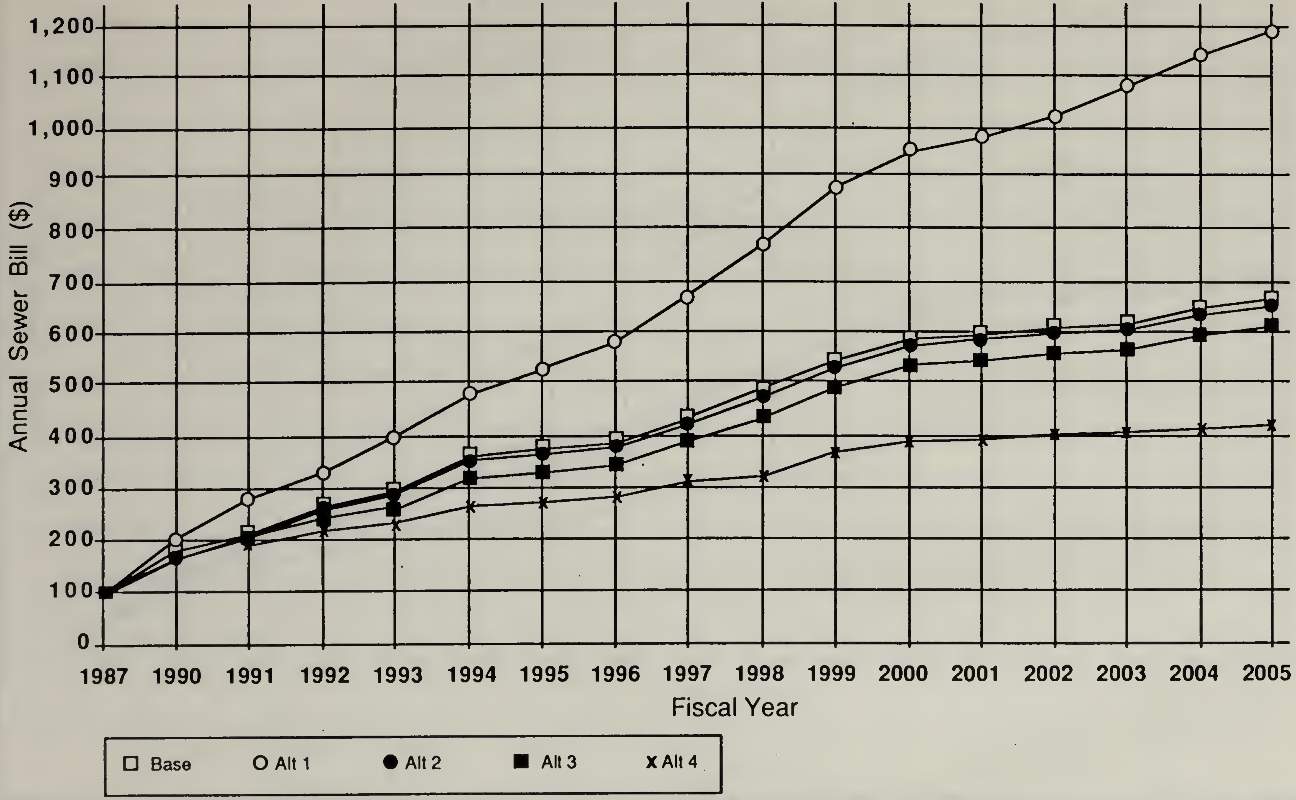

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FIGURE 7-2
PROJECTED SINGLE FAMILY SEWER BILL
BOSTON WATER AND SEWER COMMISSION

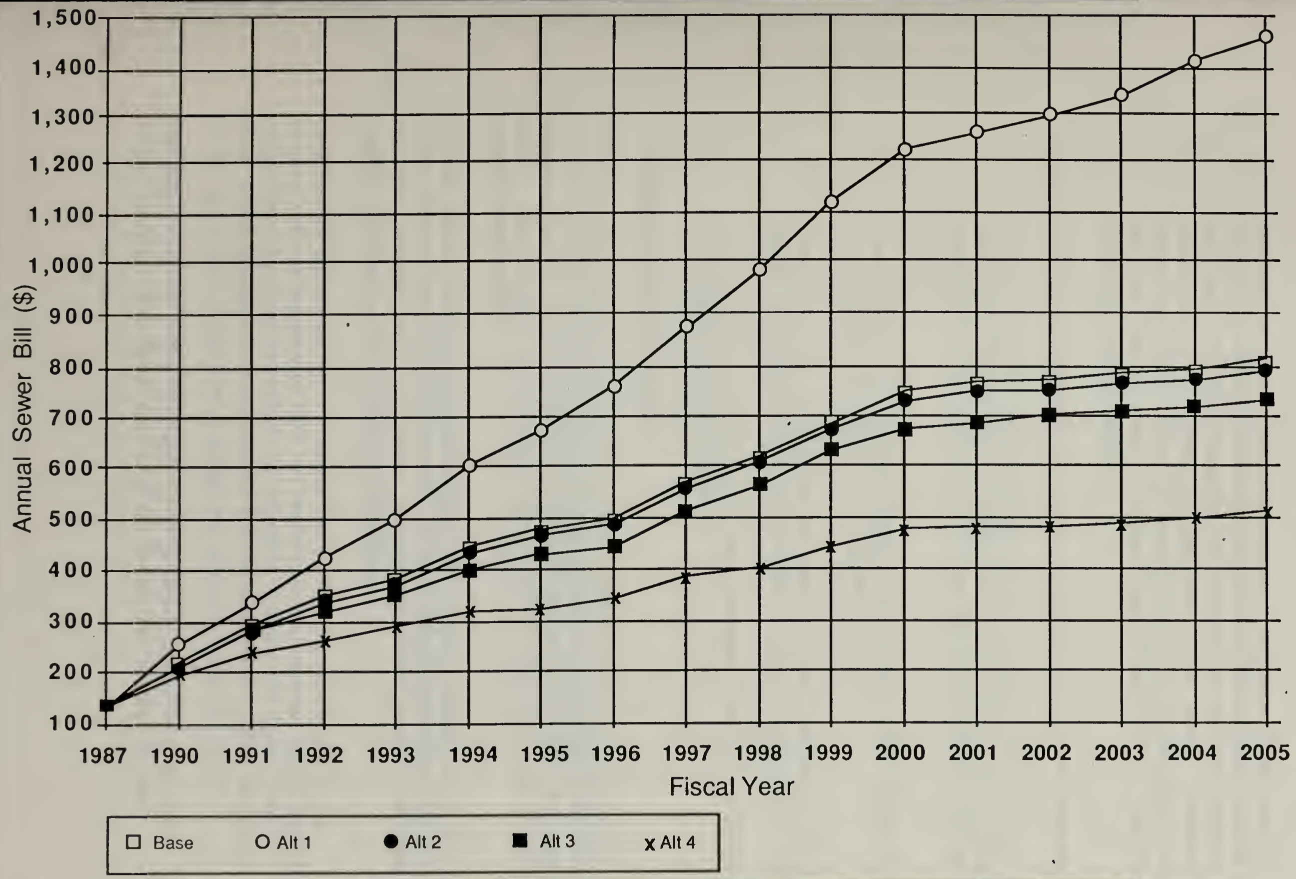

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FIGURE 7-3
PROJECTED SINGLE FAMILY SEWER BILL
TOWN OF NEEDHAM, MA

inflationary impacts. To determine the impact of the Boston Harbor Clean-Up Program, an analysis of projected assessments and retail sewer bills was made assuming no new construction other than the projected administrative, interceptor and pumping station projects, and no new operating costs associated with new facilities. Without the required construction projects and associated operating costs, retail sewer bills in Boston and Needham would still increase to approximately $200 for a single-family user under the base case assumptions.

To alleviate the financial burden on local ratepayers, the following actions are recommended:

- o Creation of a State Revolving Fund (SRF) which will supply low-interest loans for financing wastewater plants. The SRF would be capitalized with an 80 percent federal contribution (as authorized in the 1987 Clean Water Act) and a state contribution of 20 percent.

- o Re-authorization of the State Construction Grants Program which currently provides financing for 55 percent (or more) of eligible project costs.

- o Expedition of early site preparation and design activities to maximize the use of the existing Federal Construction Grants program prior to its expiration in FY 1990.

- o Use of value engineering and construction innovations to maintain cost control through the design and construction phases.

7.4 HUMAN RESOURCES NEEDS

The best-planned, designed and constructed wastewater facilities will not perform properly unless staffed by qualified, adequately compensated, dedicated and appropriately trained and managed personnel. MWRA's new treatment facilities will require a significant expansion in the number of staff, the degree of staff skills and the systems used to operate and maintain the existing MWRA facilities.

By 1995, MWRA's facilities will require a staff of 419. At project completion in 1999, a staff of 540 will be needed to operate the facilities. This staffing requirement is more than double the number of existing staff. It is necessary, therefore, that MWRA expand its operational capability concurrently with the building of the facilities.

To prepare for facilities start-up, it is essential that the following activities be initiated in spring 1988 and completed by 1991: (1) development of a preliminary plan of operation; (2) adoption of an organizational structure; (3) preparation of position descriptions, salary levels, benefits packages and hiring schedules; and (4) development of critical management control systems such as maintenance management, safety and emergency response.

The ability to meet the staffing requirements is complicated by unique local and regional factors including: (1) the Boston Harbor (island) location of the facilities; (2) the

difficulty in commuting to the facilities; (3) the strong competition for skilled labor; (4) the lack of a large pool of personnel with wastewater-related skills and experience; and (5) the area's economic climate, particularly the high cost of housing.

These difficulties must be overcome as the proper placement of staff in the required positions is also a critical issue in starting up the treatment facilities in a phased program. The phased approach places a heavy demand on the management staff to ensure that existing personnel are in place and properly trained in a continuing effort to meet the required effluent limits.

A well-conceived and managed recruiting plan, in conjunction with competitive compensation and attention to the provision of special transportation and scheduling accommodations, will assist in meeting the skill and staffing requirements. In addition, the MWRA should evaluate the use of private contractors to operate certain key areas of the recommended facilities. The power and oxygen generation systems are prime facilities that should be considered for private operation. The overall maintenance program should be carefully evaluated to determine whether certain other maintenance tasks could be performed most effectively by highly-qualified and specialized private contractors and equipment vendors.

The MWRA also should use private contractors to conduct or assist in conducting the necessary training programs. An outside contractor could provide training, including setting up the temporary training center, preparing the materials, providing instruction and establishing an evaluation system. An alternative approach is to have treatment plant staff participate as part of the contractor team. This approach would provide a learning experience for plant training staff in the preparation of training materials, lesson plans, visual aids, instruction and organization of future programs.

The final approach for recruiting and training operating staff should be developed by the Authority, in consultation with the Program and Construction Manager (P/CM) and Lead Design Engineer (LE) retained for the Deer Island-related construction effort.

7.5 REQUIRED LEGISLATIVE AND REGULATORY ACTIONS

The legislative and regulatory actions necessary for constructing the recommended facilities pertain to capital financing mechanisms. The two major items are:

- Elimination, or substantial modification, of the current $600-million ceiling on the MWRA's borrowing capacity.

- Obtaining of clear legislative authority to contract, if deemed desirable, with private-sector firms for the simultaneous responsibility of designing, building, and/or operating some or all of MWRA's facilities.

7.6 INTERNAL AND EXTERNAL COORDINATION REQUIREMENTS

Implementation of the facilities plan will require a high level of coordination by the Authority of its own capital projects and management initiatives as well as coordination with

other non-MWRA projects. The major related MWRA projects include:

- o MWRA Capital Projects -- a series of capital initiatives designed to upgrade the current treatment capability and to plan future programs for residuals management and reduction of Combined Sewer Overflows.

- o Mitigation Management -- the development of an internal management mechanism to ensure that the Authority will carry out its commitments to Winthrop, Boston, Quincy, and other affected communities. The success of the Deer Island facility and the overall reputation of MWRA will depend largely on its ability to be a "good neighbor" to those who reside near or are affected by its facilities.

- o Infiltration/Inflow (I/I) Management Program -- the development of an Authority program to manage the level of I/I entering the wastewater treatment system, thereby enhancing the performance of the new facilities and diminishing the need to build additional capacity into the system.

The major external coordination requirement is to maintain close contact with the Central Artery/Third Harbor Tunnel project directed by the Massachusetts Department of Public Works (MDPW). Joint planning may uncover opportunities for cooperative projects. Specific areas of cooperation might include: (1) re-use or disposal of excavated material; (2) concrete and labor supply; (3) shared pier facilities; and (4) sequencing of construction bids.

7.7 MITIGATION PLAN

A significant mitigation package was developed as an integral part of MWRA's 1985 decision to site the new secondary treatment facilities on Deer Island. Because MWRA is committed to alleviating the impacts associated with the construction and operation of the treatment facilities, the previous mitigation commitments have been an integral part of the facilities planning proccess.

In the Final Environmental Impact Report on Siting of Wastewater Treatment Facilities for Boston Harbor (FEIR) (MWRA, 1985) mitigation commitments were identified in the following areas:

- o Flow and Growth
- o Operation and Maintenance
- o Odor Control
- o Noise Control
- o Barging and Busing
- o Trucking of Liquid Chlorine
- o Relocation of Deer Island House of Correction
- o Further Measures to be Examined

The following summary of the mitigation commitments identified in the siting FEIR, and mitigation activities which are proposed in the Secondary Treatment Facilities Plan EIR/EID,

provides the current status of the mitigation planning for the project. It is anticipated that the mitigation plan will be revised, clarified, or expanded as the Facilities Plan receives public review. A final mitigation plan will be presented to the Board of Directors for approval in May, 1988.

Further details on these commitments are described in G.L. c. 61 Findings.

Flow and Growth

MWRA has committed to an aggressive program to avoid overloading the new treatment facilities planned for Deer Island, and to avoid future expansion to the extent possible. MWRA will implement flow management techniques as well as a program to avoid excess pollutant loading. If necessary, future considerations may include flow control structures and satellite treatment plants to minimize peak flows.

Estimates of wastewater flow and pollutant loading have been employed as the basis for wastewater transport, treatment, and outfall project components. In developing the design basis flowrates which have been used for the secondary treatment facilities planning, a sensitivity analysis was performed to assess the magnitude of future growth impacts. The recommended design basis flowrates which are being used for the Secondary Treatment Facilities Planning Project are projected to the year 2020, and are summarized as follows:

Annual Condition	Combined Flowrate
Average flow, low groundwater	390 MGD
Average flow, high groundwater	670 MGD
Annual average flow	480 MGD
Peak flow during storm conditions	1270 MGD

Ongoing MWRA projects which support the implementation of these commitments include the following:

- Draft I/I management policy;
- Water conservation program for long range water supply study;
- Improved water metering program;
- Studies for wastewater monitoring;
- Industrial pretreatment program;
- CSO facilities planning study.

Operations and Maintenance (O&M)

MWRA is committed to improve operations and maintenance. For the Secondary Treatment Facilities Plan, early planning for operation and maintenance has been included:

- A preliminary plan for the Maintenance of Plant Operation during Construction has been prepared. It describes the transition from existing to new facilities, incorporate

consideration of permit discharge compliance, plant access, mitigation requirements and interim facilities, if needed.

- o A conceptual plan of operation has been included to identify the additional or unique O&M requirements of the recommended facilities, including staffing and associated special training needs, and estimated budget considerations.

Odor Control

MWRA is committed to the construction of a facility that will control odors to eliminate detectable odors offsite, to protect the public health, and to minimize, to the extent feasible. objectionable odors onsite. Criteria for evaluating the potential for odors and other air emissions associated with alternative plans were considered in all secondary facilties planning project components.

Proposed mitigative measures for odor control include the following:

- o Conceptual site planning, in general, has located treatment operations having a high potential for odor production in the southern portions of Deer Island; facilities for residuals handling are located on the southernmost portion of Deer Island.

- o For early site preparation, the excavation and disposal of the grit and screenings will be performed during the cooler months (November through March) to minimize odors.

- o The secondary treatment facilities plan includes air emissions modelling and impact evaluations performed in accordance with DEQE requirements, which support a facility design protecting public health. These evaluations have recommended the covering of grit chambers, primary clarifiers and aeration tanks; and the treatment of off-gases to remove both odors and volatile organic compounds. A two stage treatment system, consisting of wet scrubbing and carbon adsorption, is recommended for controlling air emissions.

Noise Control

MWRA has committed to comply with all legal standards and has set a noise abatement goal that goes beyond simply adhering to applicable codes. MWRA will examine the need for noise abatement throughout the design, construction and operation of the facility to avoid adverse noise impacts. MWRA will also establish an acoustic review board and will solicit community involvement in the noise control program.

The ongoing development of noise control mitigative measures for use during construction of the secondary treatment facilities has resulted in the proposal of several concepts to date, including:

- o Construction activities which affect off-island noise, such as the construction of

landforms at the northern end of Deer Island, and pile driving would be limited to daytime operation.

- At Deer Island, a noise barrier berm would be constructed at the northernmost portion of the island to control off-island noise from construction and other noise-producing operations.

- Various mitigative techniques such as the use of quieted bulldozers, and pile driving shrouds would be employed to control off-island noise.

For facility operation, noise controlling and mitigating measures which are proposed include the following:

- The designs of major buildings would include provisions for the application of acoustical absorptive materials.

- Building ventilation openings would either be oriented away from noise-sensitive receptors, and/or be silenced. Ventilation fans will be silenced.

- All exterior motors and most motors located in buildings would be of a quieted design.

- The gas turbine power generating equipment would include intake and exhaust silencing, and an acoustical enclosure.

- Compressors would be provided with intake and discharge silencers.

- Above-ground, exposed piping in the cryogenic plant would be provided with acoustical lagging. The cryogenic plant would include molecular sieve prepurifiers.

Barging and Busing

MWRA has committed to: prioritizing the construction of on-island piers and limiting trucking volume during pier construction; upon completion of pier facilities, barging almost all heavy construction equipment and materials with a limited level of contingency trucking; busing construction workers; and investigating the practicality of providing ferries to transport construction workers. The On-Island Water Transportation Facilities Project has evaluated the feasibility of ferrying approximately one half of the construction workers to Deer Island.

Activities which implement the above mitigation concepts are proposed as follows:

- Planning for early site preparation has recommended that the total quantity of sand used for construction of the new grit and screenings secure landfill be transported to Deer Island by barge, prior to the completion of pier facilities.

- Scheduling of construction shifts and materials deliveries involving automobile and truck deliveries over land, to off peak hours;

- Provisions for monitoring traffic during construction to correct problems if any arise;

- One half of the construction workers will travel by bus to Deer Island; it is anticipated that the On-Island Water Transportation Facilities Project will provide for ferry transport for the remaining construction workforce. Preliminary recommendations are expected to be made for using three satellite parking areas, tied into a busing loop. Improved parking facilities will be provided at the satellite areas, if needed.

- Mitigation measures associated with providing overland transportation and ferrying from three dock facilities are expected to be proposed by the On-Island Water Transportation Facilities Project.

Trucking of Liquid Chlorine

MWRA has committed to cease the trucking of liquid chlorine through Winthrop as soon as possible upon marine access facilities becoming operable and the transport of alternate disinfectant or barging of liquid chlorine being feasible. Planning for interim disinfection facilities using sodium hypochlorite instead of liquid chlorine, is currently being performed by MWRA. The secondary treatment facilities plan evaluations have recommended the use of purchased sodium hypochlorite for disinfection.

Relocation of Deer Island House of Correction

MWRA has determined that the Deer Island House of Correction must be relocated; relocation is a mandatory mitigation measure. All secondary treatment planning is predicated on the requirement for the earliest relocation of the House of Correction. If relocation is delayed beyond 1989, mitigative measures would be required relative to ongoing House of Corrections operations, which may include:

- Relocation of security fencing, the prison recreational area, and the parking lot;

- Potential mitigative measures for controlling noise at the prison, such as providing noise barrier fencing in designated areas.

Outfall Siting and Design

The selection for the recommended outfall site represents a mitigating measure, since the recommended location represents the most acceptable, composite solution with respect to all of the environmental issues. Furthermore, the recommended outfall design, consisting of an effluent tunnel bored through rock, and drilled outfall riser shafts, significantly mitigates construction impacts to the marine commuinity which would otherwise be expected as a result of alternative construction techniques such as dredging.

Further Measures to be Examined

EOEA, in its final certification, recommended that MWRA consider earlier implementation of certain additional measures. Within this facilities plan, MWRA will examine other suggestions such as the concept of a "sewer bank", additional flow measurements, odor panel formation, odor monitoring, and formation of an acoustic review board.

Additional mitigative measures which have been proposed in the preliminary facilities planning documents include the following:

Historical and Archaeological Resources

- Temporary protective measures (e.g., fencing, limitation of construction activities, etc.) would be provided for historic structures which will not be demolished as a result of site development.

- Documentation for the Historic American Building Survey would be performed for historic structures which will be demolished (i.e., the Hill Prison and the Farmhouse).

- The Pumping Station and Superintendent's House would be reused within the secondary treatment facilities plan. Reuse would entail building renovation, and in the case of the Superintendent's House, relocating the building.

- The New Resthaven Cemetery would be preserved by the addition of fill material to create visual and noise barrier landforms. Provision for erecting permanent boundary markers, formal documentation, and relocation of the existing concrete cross will be considered.

Erosion and Sedimentation Control

- Surface runoff will be diverted away from areas under construction, by using hay bales and/or diversion ditches.

- Surface runoff from areas under construction will be directed to holding ponds, silt traps, etc.

- Temporary stabilization of graded areas by seeding, tacking, or mulching will be provided until permanent cover is established.

- Sprinkling trucks will be used as necessary to control fugitive dust (windborn erosion) associated with earthmoving activities.

Open Space

- The site planning evaluations have provided a separation zone that is an essential component of the treatment facilities. This zone has the potential for use as open space passive recreational use for the public at both Deer Island and Nut Island. At

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